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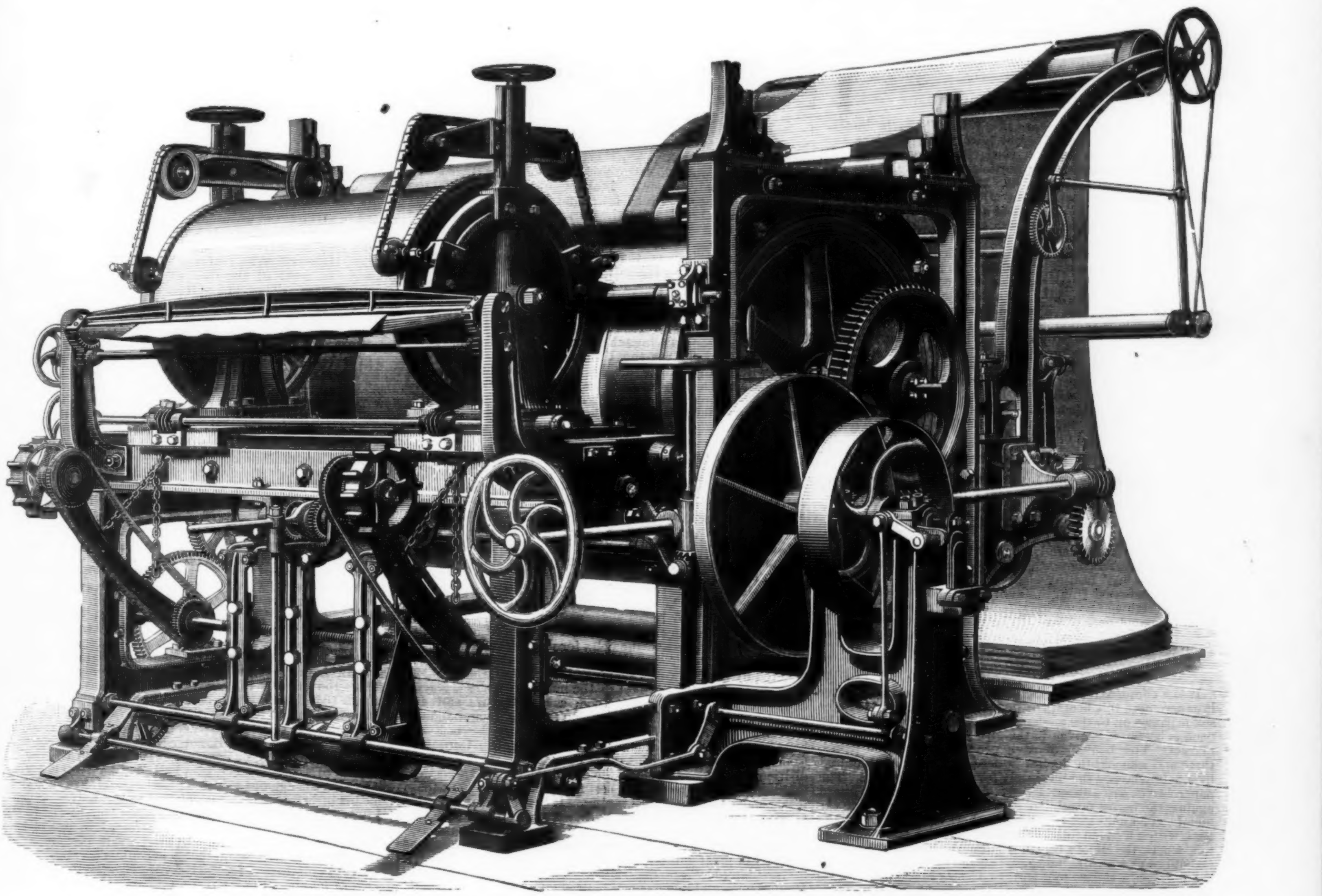
MACHINES FOR FINISHING FABRICS.

In the finishing of woven fabrics there are embraced a number of operations, according as the articles to be treated are of wool, cotton, silk, or a mixture of these, one forming the warp and the other the woof. The nature of the finish also varies, being hard or pliable, lustrous or dull, as the case may be. In addition, some tissues are treated with such materials as starch, dextrine, glycerine, gum arabic, gum tragacanth, etc. Two perfectly distinct operations are quite commonly confounded under the term "finish." The first of these consists in loading the threads with one of the materials above mentioned, and the second is a purely mechanical treatment. Cotton goods and some mixed fabrics of wool and cotton undergo both operations, being first charged with the finishing materials and afterward in diameter by four and a half to five and one-quarter feet long, heated by steam. An endless felt cloth covers nearly the whole surface of the cylinder with the exception of the places necessary for the fabric to enter and leave the machine. The tension and separation of the felt is effected by rollers. In this machine, as shown in the engraving, the piece of goods is wound on the roller in front. Pressure brakes allow the tension of the fabric to be varied. The fabric, which may be passed over a vaporizer before entering the machine, is kept at its proper width by the tension and pressure of the felt. The steam which forms in the fabric is imprisoned therein, and has the effect of isolating the filaments from each other and of swelling out the threads, thus giving the finished goods greater thickness and greater closeness of texture. The wrong side of the fabric is placed in contact with the cylinder and the right side is turned to- These disks can be fixed obliquely to produce the widening, their distance apart being regulated according to the width of fabric desired. On entering the apparatus the fabric passes between the chains and conducting disks; in turning with the oblique disks it widens, and, on reaching the other end, it enters the finishing machine, between the cylinder and the felt, where it is dried. Goods finished with this new apparatus have very even and regular edges, and the threads of the woof being well stretched and pressed, the stripes or other patterns preserve their original arrangement. In the felt machine, as we have already seen, independent of the widening, a better finish is given the goods than by other methods; and the fabric, on coming from the machine, may be folded, and is then ready for the shop. The effect of the treatment on cotton fabrics is to make them soft to the touch, almost like wool.



IMPROVED MACHINES FOR FINISHING FABRICS.—Type No. 2.

submitted to mechanical treatment to dry them. Silks of medium quality and articles mixed with cotton receive a small quantity of size, and are afterward passed through the machine. Fabrics of combed and carded wool receive a mechanical finish only. In finishing cotton fabrics the glazing material is applied, and they are then calendered on cylinders heated by steam, which gives them stiffness. But usually mechanical finishing is not resorted to, although it would be a great help. For fine cotton fabrics, however, and for carded and mixed woolen articles, it is indispensable to employ machines, so that the threads of the warp, and especially those of the woof, may be stretched, and thus given the rigidity necessary to make the fabric as stiff as it was in its raw state. The machines used for this purpose are costly, take up much room, and necessitate the employment of experienced workmen. This kind of machine applied to the treatment of fabrics, woolen and mixed, does not give a complete result, and necessitates a complementary operation. The two machines constructed by Messrs. Pierron & Dehaitre, of Paris, France, shown above and on page 4025, from *Revue Industrielle*, are a great improvement in this respect, and have been very favorably received by manufacturers of woven fabrics. The first of these, type No. 1, consists of a large copper cylinder, four to five feet ward the felt, the result being that the wrong side is made smooth, while the grain or nap of the fabric is brought out on the right side. By this system such operations may be performed mechanically as are ordinarily confided to special workmen of long experience. When the operator feeds the fabric to the felt machine it often happens that he is not sufficiently careful about the selvages, and when the goods are rolled up the ends are irregular; or, if the fabrics are striped or printed, the lines or designs are wavy, and the goods consequently do not strike the eye of the buyer favorably. There are also in woolen fabrics fulled pieces which have narrower parts, that must be brought to a uniform width, an operation that, by hand, presents some difficulty. In order to overcome these difficulties mechanically, and to obtain results superior to those gained by the No. 1 type of the machine, the manufacturers have added to the latter a widening apparatus, which is represented in the annexed cut as type No. 2. In this the different parts of the mechanism have been strengthened, and the apparatus is provided with a progressive movement (which allows its speed to be varied), and with various arrangements for rolling or folding the goods. This widening apparatus is composed of two disks, covered with caoutchouc, and of endless chains, designed for holding the fabric in place by pressure

In conclusion, we may state that these finishing machines of Messrs. Pierron & Dehaitre work with great regularity; and, as a consequence of the advantages that they possess over other systems in use, they are being rapidly adopted by manufacturers in Europe.

HOW GOLD LEAF IS MADE.

The manufacturers of gold leaf get the metal from the Assay Office in ingots, usually an inch wide and thick, and five inches long. Various shades of leaf are required, and to secure them the mint gold, which is always of the purest obtainable quality, say ninety-nine fine, is alloyed. Silver is used to lighten and copper to darken it. After the alloying it is recast in the same shape as when it was first received. Then the process of turning the bar into the leaf is begun. The ingot is first rolled between two rollers, very much like miniature working models of those employed in making boiler plates. Each time it passes through the roller the gold is heated to a high temperature and then cooled slowly, in order to render it more ductile. This annealing and rolling is continued until the bar has become a ribbon, and the fifty pennyweights or so which were contained in its five inches of length have been spread over half a dozen yards or

more. Its spread in width during this process is by no means commensurate with its length—the ingot at the end of the expanding process generally averaging an inch and a half in breadth.

SUBMITTED TO THE "CUTCH."

When the rolling is done the ribbon resulting from it is cut into squares, sized by its width, and the squares are placed between the leaves of a book made of a peculiar composition of animal and vegetable fiber, whose manufacture is a secret of the place which makes it. The best, in fact the only good "cutches," as these books are called, are made in London. They are three inches square. In the "cutch" the gold is hammered with fifteen pound mallets till it spreads to the edges, losing half its thickness and gaining in width. It takes about half an hour to accomplish this. The leaf is then removed, cut into four equal squares, and treated to another hammering.

STILL ANOTHER HAMMERING.

This second gauntlet it runs between loose leaves made from the intestines of the ox, and about four inches square. The preparation of these folios is one of the most sacred mysteries of the craft, and the few people who enjoy the secret make it pay. Conglomerately with the gold they are called the "shoulder." When the leaves are put in, the edges are wrapped in vellum, and the pack tightened with a strip of reed, when the bundle is pounded for an hour and a half with an eight pound hammer. It may as well be mentioned here that, between each beating, the gold is rubbed with roasted and powdered talc, which removes greasiness and renders it less liable to break. In the beatings, too, it is kept constantly moving round and round, so that the heat generated by the action of the hammer shall be equally distributed, and the sheets kept from adhering to the leaves and preserved uniform in thickness and surface. A single blunder in this matter would destroy the "pack." The dexterity gold beaters acquire in this employment is one of the fine arts of the craft. It borders on the marvelous. With one hand wielding the heavy mallet, the other works the book round and round incessantly and with the uniform regularity of a machine. It is indeed here that brains have the bulge on mechanism. Nothing but the intelligence of the beater has so far been found to secure absolute symmetry in the work.

GOLD-BEATER'S SKIN.

After the "shoulder" comes the "pack." It is in this stage of the game that the gold-beater's skin, that famous old-time plaster for cuts, is used. Gold-beater's skin is made from the cæcum or first portion of the large intestine of the ox. Its preparation is, like that of the "shoulder" leaves, a trade secret, and about all outsiders know of it is that it is well cleaned and doubled and then tanned by a peculiar process, in which alum, isinglass, and the whites of eggs deprive it of what grease the original cleansing left. This leaves it semi-transparent and of the color of a drumhead. Dried and pressed, it is then cut into squares of a fraction over five inches. It takes 850 squares to make a book or pack, and 500 bullocks contribute each their small share to its composition. The peculiarity about gold-beater's skin is that you may pound it with a trip-hammer without harming it, yet a sick baby can tear it like so much tissue paper. Years ago, before the usefulness of the skin was discovered, the gold used to be beaten between pages of parchment rubbed with ocher to keep the metal from adhering to them. It was in this wise that the ounce of gold Pliny tells about, which was made into 750 leaves "four fingers square," was beaten; and in some small establishments the ancient fashion will be found to-day.

ALMOST INCREDIBLE THINNESS.

In the "pack" the gold receives more beating than ever. As the gold spreads out to the edges under the pressure of the hammer it is squared and put through the same process again, and this is done over and over again until the requisite thinness is gained. The leading principle in the beatings is to keep the thinnest gold in the center of the book, so that the ragged edges which protrude from between the leaves at the final beating shall be the heaviest. This will be best understood from the knowledge that only from seventeen to eighteen pennyweights of the fifty contained in an ingot come out perfect leaf. The rest, or "scrap" as it is called, has to be worked over again. The hammer used in the "pack" process weighs about seven pounds.

MADE INTO BOOKS.

It is a compensation to the poor, battered metal that after it experiences this brutal treatment at the hands of the ruder sex it passes on to the tenderer care of the ladies. After the pack is beaten it is given to the girls to be booked for the market. The books are of a peculiar, soft tissue paper, three and one-eighth inches square, and are manufactured by a man who has the monopoly for the United States. The paper leaves are rubbed lightly with red ocher to guard against the barest possibility of adhesion on the part of the metal. The gold leaf is removed sheet by sheet from the pack with a wooden tongs or pincers, laid on a leathern cushion, where the dainty breath of the workwoman blows it smooth, and with the "wagon," an instrument provided for the purpose, a square tool with two knife runners like those of a sled, cut in exact squares. Any breaks or holes are patched with loose pieces from the ragged edges, and the gold is placed, leaf by leaf, in the books. Each filled book contains five and one tenth grains of leaf, and they are packed twenty to the bundle, worth about eight dollars. The girls get two cents a book for filling, and sixty books is a good day's work.

DENTISTS' GOLD.

The gold leaf used by dentists is not beaten as fine as that for the bookbinder, the painter and printer, but must also be as absolutely pure as gold can be made. For this purpose it is first refined. In order to make that spongy foil which is the dentist's necessity, the leaves of gold are put in paper books in a press. The entire arrangement is then exposed to such a degree of heat that the paper is carbonized, drawing the gold into a reflex of its shrunken surface. The sheets are then laid together and cut into shape.—*Sunday News.*

THE British Secretary of Legation at Washington has just sent in his report down to August 1. It shows that the States were never so prosperous and stable as they have been lately. The failures for the first half of 1880 appear to be for the whole United States only 2,497 in number, with liabilities amounting to barely $33,000,000. Railroads are having more prosperous returns than before, and agriculturists were never so well off as they are now, after having enjoyed three unprecedentedly good harvests in succession

ENGLISH AND AMERICAN CITIES.

AN official calculation of the population of English cities has just been made public in England by the Registrar General of Statistics, in accordance with a law requiring such calculation annually for statistical purposes, in the interim of the actual census enumerations. The results afford the opportunity to make interesting comparisons with the cities of the United States, and at the outset they appear unexpectedly favorable to the view that we are rapidly gaining on the Old World. Apart from London, which maintains its supremacy by a growth of 366,000 in eight years, the other great cities of England fall below the measure of the cities of the United States. Liverpool has 538,338, and is no more than the equal of Brooklyn or Chicago. Manchester has 361,819, gaining only 10,630 since 1871; Leeds, 311,860, and Bradford, 191,406. These three cities together aggregate 864,665, or but little more than Philadelphia alone. Or, if Salford, which is a kind of Brooklyn to Manchester, with 177,849 inhabitants, is taken instead of Bradford, the three cities are almost the exact equal of Philadelphia. Manchester alone has usually been thought directly comparable with Philadelphia, and its equal in manufactures as well as in population. But a city of 361,819 inhabitants only cannot possibly compare with one having much more than twice as many.

Sheffield, with 297,138, and Birmingham, with 358,000, represent the industries in iron. Hull, with 146,347, Newcastle, 146,948, Portsmouth, 138,121, and Bristol, 209,947, are chiefly commercial. These have increased about 10 per cent. in the eight years since 1871, as Liverpool has also. Oldham, with 111,318, is a coal and iron town, which has increased 20 per cent.; Sunderland, 114,575, a coal-shipping city, also has gained 20 per cent., as has Leicester, 125,622, a textile manufacturing city. The centers of textile manufactures, Manchester only excepted, have gained 20 per cent., as have most of those in iron manufactures, while the commercial cities have gained but ten per cent. Liverpool, Bristol, and Portsmouth are somewhat disappointing, and it appears anomalous to find that Brooklyn, Chicago, Cleveland, and Louisville are running away with the historic cities of British commerce. Manchester is also disappointing; even adding its adjacent city of Salford to its 361,819 the total is 330,000 less than Philadelphia with Camden, or 310,000 less than Philadelphia alone. Manchester has gained but three per cent. in eight years since 1871.

The aggregate population of fifteen of the chief cities of England is 6,843,000, London being more than half, while the aggregate of fifteen of the largest in the United States is 5,654,282. Another decade will carry this municipal growth far beyond the probable growth of English cities, especially as to cities of the interior having a population of 100,000 to 200,000. The great value of fixed and leading industries is apparent in this English list, the presence of these being the only assurance of continued prosperity. A long list of towns once conspicuous in English history have dropped out of existence almost, because they had no industries, while fixed industrial centers have held their own for centuries. Manchester and Leeds still conduct industries as old as the fourteenth century.

It was claimed as a triumph in 1871 there were twelve English cities having 100,000 inhabitants or more, and now this calculated report brings the number up to sixteen. But the census of 1880 gives the United States twenty of this rank, with many others closely approaching it. On the whole, American cities compare well with those of Europe, and if the comparison were extended to the Continent, it would be even more favorable than in its relation to England alone.—*Phila. Ledger.*

THE TRADE IN HIDES.

THREE million head of cattle are now feeding on the plains of Texas, Mexico, and Guatemala, the pampas of South America, and along the rivers of the East Indies, whose hides, within two years, will be distributed in every township in the United States in the shape of shoe leather. Last year 2,700,442 hides were imported in this city and Boston. By far the greater number was received here. Thus far this year the receipts are 1,700,415 skins. Fully half the number of cattle represented by these hides were slain for their hoofs, horns, bones, and pelts. The hoofs and horns and bones were used in making buttons, combs, and clarifying sugar; the sinews and trimmings in glue manufactories; and the pelts for making leather. Over a third of last year's importation came from the district watered by the Rio de la Plata and its tributaries. Such hides are accounted the best in the market. The grass and climate of the pampas give them a fine texture and an abundance of gelatine. The gelatine thoroughly assimilates tannin with the fiber of the hide, and makes the best of leather. Montevideo, Buenos Ayres, Corrientes, Cordova, Concordia, and Entre Rios hides come from the La Plata district, and rank in value in the order named. Experts say that the Buenos Ayres is the best hide that grows, but that it is usually badly cut in skinning. It brings about twenty-four cents a pound in market. An excessive importation of La Plata hides this year is due to a famine on the pampas. Herds of cattle have died from starvation, and their pelts are shipped in great quantities.

Brazilian hides are dry salted. They are shipped from Pernambuco and Bahia, ports between Cape St. Roque and Rio Janeiro. The cattle are raised on the Atlantic slope, and their hides are of an inferior grade. They are much coarser than the La Plata pelts, having more fiber and less gluten. This is a prevalent characteristic of hides grown near the sea coast. Many Brazilian and Corrientes hides are disfigured by the marks of ticks, or flies. Brazilian hides sell here for less than one-half the price of La Plata skins.

Venezuelan pelts are of a much better grade. They have short hair, a close texture, are well flayed, and are not scarred with brands. The best are the Angosturas, or Ciudad Bolivars, brought down the Orinoco River. Those raised in Caracas and adjoining provinces are shipped from Laguayra. They are quoted here at about twenty-three cents a pound. Colombian and Bogota hides also bring a good price. They are packed over the mountains of New Granada on the backs of mules, and reach market via the Magdalena River. They are called booked hides, because before packing they are folded like the leaves of a book. They are also closely trimmed. In other words, legs and neck strips, and similar pieces are cut off. They have a fine texture, and, were it not for one defect, would be as good a hide as is grown. The shoulders of fully half the cattle are covered with small sores. These sores disfigure the hides, and reduce their value when turned into leather. The Colombian is a dry hide, however, and the driest hide, all other conditions being equal, absorbs the most tannin and produces the most leather. The best lots of Colombians are valued at from twenty to twenty-one cents per pound.

A few hides from Quito and Guayaquil reach the New York market, but the most of those grown on the western coast of South America find a market in Chili. Chili is doing a great deal of tanning. In that country it is comparatively a new industry. Five years ago the Chilians imported leather from England and the United States. Now they import the hides and make their own leather. The country is flooded with German tanners, and they virtually monopolize the business. Large quantities of leather are sent to Germany.

Of Central American hides Guatemala take the preference. Costa Ricas are fairly good, but those grown in Honduras are sunburnt and show lack of care. Some are not trimmed. Hides from Campeachy, Tabasco, and Tehuantepec are usually brought here from Vera Cruz. The former are loose in texture, not trimmed, and are not plump. The Tehuantepecs are close trimmed, pretty plump, and heavy cured. Oaxacas and Acapulcos are shipped from the Pacific coast. They are pickled, and are similar to Tehuantepec hides. Pickled hides are those that have been vatted in salt when fresh and afterward dried. Dry-salted hides are those that have been piled on layers of salt as they are taken from the backs of cattle. They are subsequently framed and dried. A pure dry hide is one that has been framed, placed in the shade, and cured by the air of the plains. A pickled hide weighs a third more than a dry hide, and a dry-salted hide nearly twice as much. All coast hides are naturally poor, and their value is decreased by staking them on the hot sand, where they are burned by the rays of the sun. A dry hide, if neglected, becomes tainted and rots. Those properly dried are as good as those cured with salt.

"Winter-dried Matamoros hides make excellent leather," says an expert, "but those dried in summer are usually sunburnt. Thousands are spoiled in the warm season for want of attention. Rio Grande hides do not come from the district watered by the Rio Grande del Norte, as the name indicates, but from the lower sea coast provinces of Brazil. You can say that Texas hides are badly handled. They are dried on wagon wheels, stumps, and rail fences, and, were it not for the climate, nearly all of them would be ruined. Improper care deducts a dollar in value from each Texas hide, causing a loss to the State of nearly half a million a year. Texan herders have hides that would bring as much as Montevideos or Buenos Ayres if they were properly treated. Some of them, to be sure, are injured by ticks, but this injury is a flea bite compared with the injury caused by improper curing.

"California hides are usually well trimmed," the expert continues, "but they are thin and flat, and loose in texture. They lack glue. The trouble is that the cattle are too well bred. Tanned without acid, their hides make good buffing leather. The sole leather, however, is pale and white, and is used in making the white-bottomed shoes. The skins of thoroughbreds make poor sole leather. The old long-horned Spanish-bred cattle, such as are found in Texas and South America, throw off hides that make unequaled sole leather. Hides grown north of the Gulf of Mexico are salted and used for uppers. They are softer, and contain less glue and more fiber than the hides of the old Spanish breed."

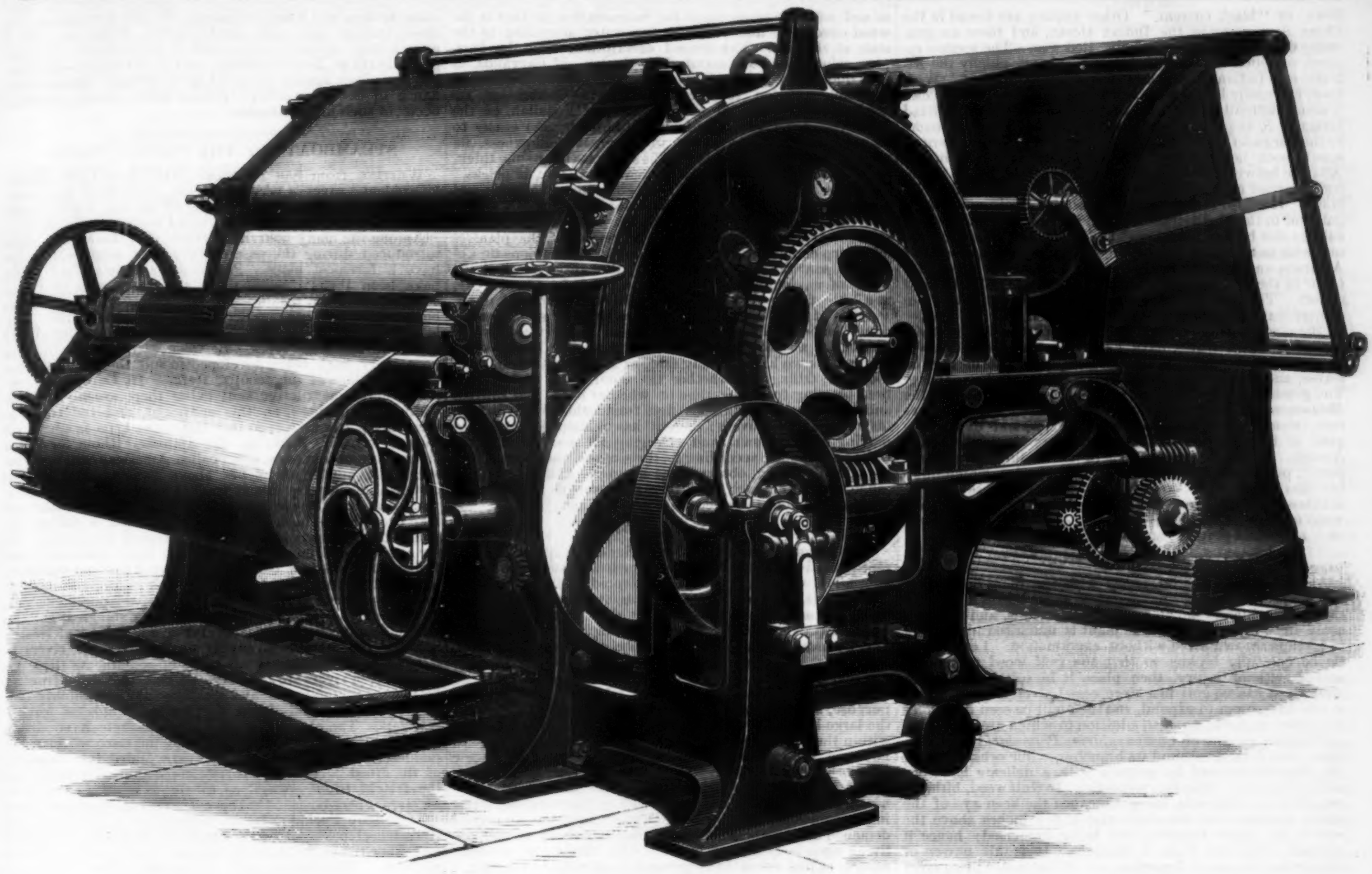
Africa sends us hides from Sierra Leone, Senegambia, Morocco, Zanzibar, and Madagascar. They are very light. Many of them are the skins of the small soft-haired animals seen in traveling menageries, and known as sacred cattle. Madagascars and Moroccos make fine inner soles, and the others are all turned into upper leather. India floods the New York market with pelts known as Buffaloes. They are small, and bear no resemblance to the hide of the American bison. Ninety per cent. of these hides find a market here, and ten per cent. goes to England and Italy. The best quality are the Patnas, grown near Lucknow. They are the skins of sacred animals, and are used mainly for uppers. The Cawnpores, grown near Delhi and Agra, are much poorer. East India coast hides are badly sunburnt, and are almost worthless. Most of these hides are shipped from Calcutta. About 1,400,000 have been tanned in this country within two years. The importation this year is enormous; over 500,000 up to the 1st of May.

If imported direct from the port of first shipment hides are admitted free of duty. All South American hides, excepting Carthagenas, brought to this port are landed in Brooklyn, between Wall and Fulton Streets. Great piles of skins cover the wharves and piers. After an assortment according to the marks of the importers, they are stored in warehouses, where they await the demands of trade. Buyers deal with importers through brokers or factors. After a purchase the buyer sends an expert known as a "culler," who sees that the hides are as represented, and who throws out those that are defective. The culler qualifies the hide at a glance. He can tell whether it came from Angostura, Montevideo, Costa Rica, Bogota, Acapulco, Campeachy, Matamoros, Tampico, or Zanzibar. He can tell whether it is the hide of a cow, a steer, or a bull, and he will even venture to give the age of the animal from whom it was taken. After his inspection the lot is shipped to the tanner at special rates. Formerly the dealer in leather bought the hides and sent them to the tanner, who contracted to return the leather for so much a pound. In after years tanners, willing to take more risk, made joint account contracts. The hides, the commission for buying, the insurance while in process of tanning, the interest on the money invested, the tanner's price for making the leather, and the dealer's commission for selling it, were charged to a joint account. A balance was then struck and the profit or loss was equally divided. As the tanning interest was developed new contracts were made. The tanner assumed all the risk, the ownership remaining with the dealer, who received his commissions for buying and selling, and interest and insurance, the tanner taking the profits. In many cases, however, tanners buy their own hides, paying a commission to a broker.—*N. Y. Sun.*

THE TRADESMEN OF ANCIENT ROME.

THE following interesting particulars in relation to the daily life of the artisans and mechanics of Ancient Rome are furnished by Prof. C. G. Herbermann.

Of manufactories on a large scale there were few in Rome, though some of the most prominent nobles owned factories in Italy and the provinces. Even the Emperors did not disdain to be interested in ventures of this kind. M. Aurelius inherited from his mother immense brick factories; and even now bricks are found bearing the name of Cn. Domitius Tullus, the Emperor's great-grandfather by adoption. Another Emperor, Pertinax, for three years conducted a felt factory in Liguria. As senators were forbidden to engage in trade, the Emperor had recourse to the usual expedient to baffle the law. He set up in business trusty freed-



MACHINE FOR FINISHING FABRICS.—TYPE NO. 1.

men and slaves who disposed of his manufactures. Other senators owned potteries or worked mines and quarries.

But though great quantities of merchandise were supplied by these factories, and the finer fabrics were imported ready made from the East, most manufactured articles were produced on a small scale in the city itself. It was truly a beehive of artisans and mechanics. Bakers, tailors, shoemakers, carpenters, smiths, dyers, tanners, fullers, potters, masons, carvers, and a host of others here busily plied their trades and earned a modest livelihood. Of shoemakers there were five or six varieties. Even the sculptor restricted himself to one branch of his art. There were artists who produced only Genii or Victories—nay, some whose sole occupation was to insert eyes into statues made by others. Two statues have been found in which the bodies were exact duplicates, though one was surmounted by the head of Augustus, the other by that of Agrippa. Some sculptors, therefore, kept on hand a supply of ready made bodies, for which heads were made to order. Of course, the price of work so produced was very low, and a respectable life-sized statue of marble or bronze could be got for one hundred and thirty to one hundred and seventy dollars, at a time when from ten to thirty thousand dollars were paid for a Phidias or a Scopas.

No doubt, many of the mechanics and tradesmen of Rome were slaves; but that a large number were free citizens must be inferred from the number and importance of their collegia or guilds. Their establishment reaches back into hoary antiquity, for they are said to have been founded by Numa Pompilius. They were associations with corporate rights, whose aim was not only to further the business interests of their members, but also to provide them with congenial amusements. Not only each trade had its guild, but sometimes each branch of a trade. For instance, there were not only goldsmith and silversmith guilds, but also a guild of ringmakers. Of their influence on business life, we have no detailed knowledge. They all worshiped Minerva, the goddess of mechanical arts, whose festival (March 19 to 23) they scrupulously kept; but, besides, each guild had some special patron, whose feast was celebrated by them with much pomp and display. The bakers, for instance, were the special wards of Vesta, the goddess of the hearth fire; and on her feast (June 9) they marched forth in procession, accompanied by their asses, which were adorned with garlands of flowers and loaves of bread.

The expenses of the artisan were not very large, for living at Rome was cheap. From an edict of the Emperor Diocletian which seems to give the maximum prices of labor and merchandise, Firbiger has conjectured that the shop rent cost from \$60 to \$75 annually, while the average yearly pay of a journeyman mechanic was from \$95 to \$125 and board. The annual cost of food he computes at \$40, and of clothing at \$15 per head. The prices of the mechanic's product were correspondingly low, as appears from the following items: 1 felt hat, \$1; 1 pair man's gaiters, 50 cents; 1 pair woman's gaiters, 30 cents; 1 pair shoes, 36 cents; 1 pair man's sandals, 26 cents; 1 pair slippers, 30 cents; 1 tunic, \$16 to \$36; 1 toga, \$20 to \$48. We must not forget to mention that a shave could be had at the most fashionable shop for 4 cents.

WATER POLO.

To the many spectators on the shore, on the pier, Hunter's Quay, and in the boats, the proceedings which took place on the 12th and 13th July caused great merriment. The efforts of the riders to get on to their unruly steeds were most ludicrous. The ball (a hollow India-rubber one), swimming on the water, was from time to time propelled by the paddles of the successful riders. Only one or two were able to keep their seats, the rest continually fell off into the water. The horses (named after famous racers) are simply barrels, with a flat board, cut in the shape of a horse's head fixed on in front. A tail is stuck on behind, and under the water line is a heavily loaded keel, to keep them somewhat steady. They are painted like toy horses, and a saddlecloth nailed on.

Our engraving is from a sketch by Mr. John Hildersheim.—*London Graphic.*

THE SARGASSO SEA.

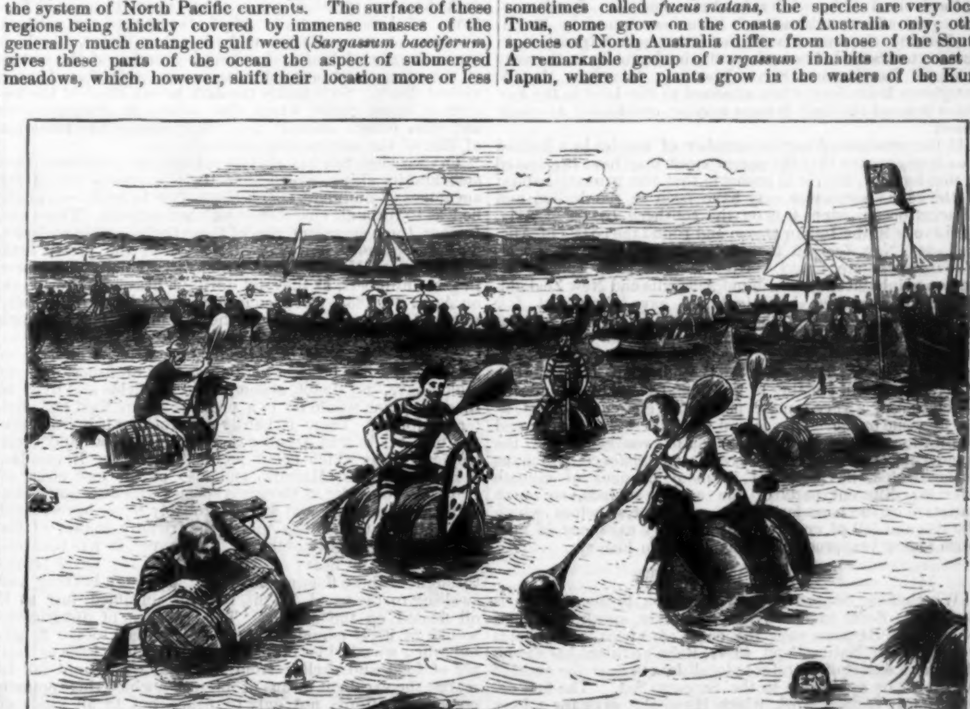
In answer to a remark in the *Herald* that no more is now known of the Sargasso Sea than was known to the contemporaries of Columbus, Mr. Gustave A. Kuhne submits the following extract from a work on "Pelagic and Deep Sea Life," soon to be published:

THE GREAT WEED SEA.

The center of the whole system of North Atlantic currents called the "Sargasso Sea" offers a wonderful feature of the oceanic flora or "Nereis," as it may be called, and we find it repeated only to the north of the Sandwich Islands, where it occupies a still larger area in the center of the system of North Pacific currents. The surface of these regions being thickly covered by immense masses of the generally much entangled gulf weed (*Sargassum bacciferum*) gives these parts of the ocean the aspect of submerged meadows, which, however, shift their location more or less under the influence of northwest winds. To an observer these *sargassum* fields present a somewhat variegated surface as regards color, the major portion of it being a dark brown interspersed with spots and patches of light yellow.

The Sargasso Sea is situated in the North Atlantic, between the twenty-second and thirty-sixth degrees northern latitude, in the comparatively quiet space which is bounded on the south by the great equatorial current, on the west and north by the Gulf Stream, and on the east by the Guinea current, which flows southward. Humboldt states that there are two principal banks, the larger of which lies a little to the west of Fayal, one of the Azores; the smaller near to the Bahamas, both together occupying about forty thousand square miles of the area of the Sargasso Sea. The situation, however, of these weed banks varies in different seasons, according to the prevalent winds. Maury states that an area equal in extent to the Mississippi Valley is so thickly matted over with gulf weed that the speed of vessels passing through it is often retarded.

The genus *sargassum*, including the gulf weed, *S. bacciferum*, here mentioned, inhabits the tropical and sub-tropical seas of both hemispheres, extending on each side of the equator to about the forty-fifth parallel of latitude. With the exception of the gulf weed and *S. vulgare*, which is sometimes called *fucus natans*, the species are very local. Thus, some grow on the coasts of Australia only; other species of North Australia differ from those of the South. A remarkable group of *sargassum* inhabits the coast of Japan, where the plants grow in the waters of the Kuro-



PLAYING AT POLO ON THE WATER.

Siwo, or "black current." Other species are found in the China Sea, many in the Indian Ocean, and these are generally distinct from those of the Red Sea. The section *cymosæ*, to which Gulf weed belongs, inhabit chiefly the Atlantic and Indian Oceans and the Australian coast. With these extremely local habits and permanently distinct species it seems difficult to reconcile the errant habits and the fixed forms of *S. vulgare* and the plant which has given its name to the Sargasso Sea. Both species are found in the warmer seas in both hemispheres. (*S. bacciferum* is found in the Atlantic between 22 degrees and 58 degrees, being sometimes carried on the Gulf Stream as far as the Orkney Islands. It is also found on the coasts of Spain and Portugal, and in the Mediterranean Sea, its presence in these localities also being due to the Gulf Stream. It is likewise met with in the Indian Ocean, the Pacific, on the coasts of Australia and New Zealand.) Slight deviations sometimes occur in these plants, but they are clearly traceable to local causes. Thus, in the Sargasso Sea the plants have often shorter leaves, the branches are contracted and the bristles of the air vessels broken off; whereas specimens from Sydney, New South Wales, have longer leaves, the air vessels have very long bristles, which frequently form narrow leaves, and the habit of the plant is more lax and straggling. The genus *sargassum* is the most highly organized of the *Melanospermeæ* or olive colored sea weeds. It possesses root, stem, branches, leaves, air vesicles, and distinct organs of fructification. The species are very numerous. Agardh, in his "Species, Genera et Ordines Algarum," part 1, published in 1848, describes 126 species, which number has since been greatly increased. These species are classified into three sections and twelve tribes. Gulf weed belongs to the highest section—namely, *Eu-sargassum*, or "*sargassum* proper," and to the twelfth tribe, *cymosæ*."

AN INTERESTING STUDY.

Almost every one who meets with the plant on his first trip across the ocean brings home a small bottle filled with the weed, which is shown to admiring friends, and then put away and forgotten. But the plant is much too interesting to be thus thrown aside without examination. Let the bottle be carefully broken so that the gulf weed may be removed without injury, then place it in salt water (in sea water if it can be got) in a large vessel of clear glass, where it will have room to expand, and then will be seen its beauty and grace of form, no small addition to which are the pretty and minute species of *Campanularia*, *Plumularia* and *Sertularia*, which twine around its branches, while other parts of the plant are covered by polyzoa with a delicate lacework as hard as stone. One fact respecting the Gulf weed, hitherto unnoticed by botanists, has not escaped the keen eye of the sailor, namely—that the plants rise a few inches above the water, the upper branches not being immersed; hence it is readily observed from a distance. It is this power of supporting the upper branches out of the water in an erect position, a very unusual power in seaweeds, that enables the Gulf weed to "tail" to the wind. Another peculiarity attending the floating weed is that no other marine plant has ever been found growing on it or with it; small zoophytes and polyzoa are, however, often attached to it. A third peculiarity affecting the floating Gulf weed is that it has neither root nor fruit; never in the Atlantic, or in other localities where it is met with, has it ever been found in fruit. *S. vulgare* produces fruit in all the localities where it is found, but with regard to *S. bacciferum* the question arises, How is the floating weed propagated? To this question Dr. Harvey, the author of the "Manual of British Algæ," replies: "It seems to me that the old frond, which is exceedingly brittle, is broken by accident, and the branches, continuing to live, push out young shoots from all sides. Many minute pieces that I have examined were as vigorous as those of a large size; but they were certainly not seedlings, and appeared to me to be broken branches, all having a piece of the old frond from which the young shoots spring. As the plant increases in size it takes something of a globular form, the branches issuing in all directions, as from a center."

The specimens brought to this country are merely the uppermost branches, the whole plant often attaining a diameter of three or four feet. The upper branches are of a light olive color, the lower more or less brown; the lowest parts of all wither and decay and finally drop away. Since the publication of these observations information relative to the fruit of *S. bacciferum* has been obtained. Specimens, "covered with fructification," have been found by Mr. H. N. Moseley, the naturalist of the Challenger Expedition, in Harrington Sound, Bermudas, which islands lie in the very heart of the Sargasso Sea. The fact, therefore, that *S. bacciferum* bears fruit when attached to the land in the Sargasso Sea and the Gulf Stream may be considered as established.

If the presence of a great number of species in a limited area is suggestive that the parent stock may have originated in that locality, then it is probable that the primary habitat of the genus *sargassum* may have been in the Indian and adjacent oceans, since it is on the southern coasts of Asia, the islands in the Indian Ocean and round the coasts of Australia and New Zealand that the greater number of species of *sargassum* are found. No less than forty species are known to inhabit the seas around Australia and New Zealand. Numerous thorough investigations have furnished fair grounds for the opinion that many of the tropical *algæ* of the three great oceans are probably among the oldest forms of this class of plants—*S. bacciferum* and its congener *S. vulgare*, also *S. dentifolium* and other *algæ*, therefore be "survivals" still existing in health and vigor of the marine vegetation of a very remote period, as ancient, at least, as the miocene epoch. One cannot but look with wonder and admiration, mixed with somewhat of veneration, on the wandering *sargassum*, still in vigorous existence, which, as authenticated, has survived so many changes of climate affecting different parts of the earth's surface, so much variation on the boundaries of the seashores, before which the rise and fall of empires and the very existence of man form almost inappreciable items in its life history.

FIRST SEEN BY COLUMBUS.

Whether the Sargasso Sea was known to the ancients is doubtful. Some ancient writers, however, speak of a kind of *mar de Sargasso* near the coast of Africa. Humboldt ("Aspects of Nature," pp. 46, 47, Bohn's edition) has shown that these descriptions refer to localities too near the coast of Africa to be applicable to the Sargasso Sea. The first description is from a work which Humboldt says for a long time bore incorrectly the name of Aristotle. It is as follows: "Phœnician mariners came in a few days' voyage from Gades to a place where the sea was found covered with rushes and seaweed. The seaweed is uncovered at ebb and overflown at flood tide." There are no "rushes" mixed with the seaweeds in the Sargasso Sea, neither is the weed covered or uncovered by the water according to the state of the tide. The second description, from the Periplus, which has been ascribed to Scylax, of Caryanda, is thus quoted by Humboldt: "The sea beyond Cerne (the Phœnician station for merchant vessels—Gaulea—or, according to Gosselin, the small estuary of Fedallah, on the northwest coast of Mauritiana. Humboldt, *ib.*) ceases to be navigable in consequence of its great shallowness, its muddiness, and its sea grass. The sea grass lies a span thick, and it is pointed at its upper extremity, so that it pricks." Now the Sargasso bank is in deep water, which is not muddy, and no sea grass (which inhabits shallow water) ever grows on it. The Sargasso bank is much more than a span in thickness, and the upper extremity of the plant is not sharp enough to prick. When the companions of Columbus saw the Sargasso Sea they thought it marked the limits of navigation and became alarmed, for, to the eye, at a little distance it seems substantial enough to walk upon. Patches of the Gulf weed are generally to be seen floating along the outer edge of the Gulf Stream. The weed always "tails" to a steady or constant wind, so that it serves the mariner, as we have already said, as a sort of marine anemometer, telling him whether the wind as he finds it has been blowing for some time or whether it has just shifted, and which way. Columbus first found this weedy sea on his voyage of discovery; there it has remained to this day, moving up and down, and changing its position, like the Calms of Cancer, according to the seasons, the storms, and the winds. Exact observations as to its limits and their range, extending back for fifty years, assure us that its mean position has not been altered since that time.

ITS ANIMAL LIFE.

The Sargasso Sea affords subsistence to quite peculiar representatives of the polyps, mollusks, crustaceans, fishes, etc., all of which are specially adapted to life among the Gulf weeds. Among these there is, for instance, the *Antannarius marmoratus*, a small fish allied to the "angler," which is provided with long, slender, and arm-like pectoral fins, by means of which it rests upon or clings to the floating weeds. The fish builds a nest of the weeds, binding together a globular mass of it as big as a man's head, by means of sticky, gelatinous strings, which it forms for this purpose, and which prove amply strong enough to support the large bunches of eggs which hang like grape clusters within their orbicular case. These nests are occasionally to be found, but cannot be considered common, and only a few have been obtained from the weed on the Bermudan shore. There is, further, a *Bryozoön*, or moss animal (*membranipora*), which covers the weeds with an incrustation, forming conspicuous white patches upon it, and the numerous detached air vessels of the weed, floating about among the living weed beds, coated entirely with this white *membranipora*, at first resemble very much small pelagic animals.

All the representatives of the fauna of the Sargasso Sea are most remarkably colored for the purpose of protection or concealment, exactly like the weed itself. Most of the crabs and shrimps disporting themselves among the weeds are of the same yellowish coloring as the weed, and the white patches upon their bodies represent the incrustations of the *Bryozoön*. The largest of the shrimps are of a dark brown color, which is also that of the older pieces of weed, and the brilliant white and sharply-defined areas which adorn them are a true imitation of the *membranipora* upon these dark-colored weeds. The "marbled angler" above mentioned has the same weed color and white spots, and there is, further, a mollusk (*Scyllæa pelagica*) and a Planarian worm inhabiting these weeds, which are of a similar color. The white patches on these pelagic animals may also represent to some extent the white shells of the barnacles which occur in the weed: but the most astonishing case of such protective coloring is undoubtedly found in the *Nautilograpsus minutus*, a small crab abundant among the weeds, and it appears, indeed, quite insignificant that the large numbers hanging on to floating logs, covered with barnacles, are protected by white markings, representing the latter, compared with the fact that the same creature, when found clinging to the floats of the pretty blue-shelled pelagic mollusk, *Ianthina*, is of the same blue coloring for concealment. It seems that pelagic animals in general are rendered less conspicuous to the eye of their pursuer, either by special coloring or in being colorless and transparent, and the dark blue or purplish color of the above-mentioned *Ianthina*, of *Velella*, and the allied *Porpita*, of the mollusk *Glaucus*, of some *Medusæ* and of certain *Salpæ*, in which the nucleus is of that tint, which is also that of the waters of the ocean, may in many instances preserve them from a violent death. So is finally the dark brown color of the nucleus of many *Salpæ*, which also occurs in *Pelagonemertes* and other pelagic animals, most likely a protective imitation of that of the surrounding seaweeds.

The Sargasso Sea has also its pelagic sea anemones (*Nautactis* and its allies), which have their bases—by which the anemones of our coast attach themselves to rocks—so modified as to form air chambers which act as floats. There are, further, these singular forms of those truly oceanic acalephs, *Velella communis* and *Physalia pelagica*, the pretty little "Portuguese Man-of-War," which occasionally occur here in great numbers, as they did during a heavy southerly gale on April 10, 1861, when countless myriads were literally wrecked upon the shores of the Bermudas, together with the shells and rafts of *Ianthina*.

About the margins of these floating fields, which are of some depth, may be seen various species of fishes, most of which have, no doubt, accompanied the fields and lived in them, as game would do in a preserve where food and shelter are found. There is hardly a doubt that it is from this fish preserve in mid-Atlantic that those tropical and semi-tropical forms which occur incidentally at the Bermudas, Azores, Canaries, Madeira, and also at the east coast of America, come, for at Bermuda species which are not recognized as Bermudan, and would probably never have visited the island waters unless under the friendly shelter of the weed, are frequently obtained. Moreover, it has been observed, even in heavy storms, that the sea never breaks throughout these floating fields, but, although heaving and swelling to the usual height, remains unruffled, just as if oil floated on the surface. This absence of disturbance would of itself commend the field of weed to the fishes; but when we consider other suitable adjuncts, such as supply of food and shelter from enemies, we cannot fail to realize the excellent means of migration which this common possession affords not only to fishes, but to all kinds of those lower invertebrate forms, many of which have most certainly been brought to the shores of the Bermudas by this means.

The isolated patches of the *S. bacciferum*, which, as aforementioned, follow the source of the Gulf Stream, and become broken into lesser fragments, are also accompanied by these tropical and semi-tropical fishes, which are found almost every summer on the coast of Nova Scotia, and even as far north as Newfoundland; and it is evident that without some such agency we could never account for the abundance of certain southern pelagic fishes, which annually occur in such high latitudes.

STEAMBOATS OF THE PACIFIC COAST.

WRITING from San Francisco to the New York *Herald*, "Occident" gives a very intelligent account of the peculiarities of the steamboats employed on the Pacific coast rivers—Columbia, Sacramento, and Colorado. He says:

Among the many bold innovations that Americans have introduced during the past century river steamboats must have a foremost place. Precedents and data of all kinds have been thrown aside; the whole matter was gone into *de novo*, and the result is at last three types of steamboats which have no parallel elsewhere in the world. The lake propeller, Atlantic coast, and Mississippi steamboats constitute the three types. Between them there is little or no analogy, each being developed to suit the circumstances and conditions of the peculiar traffic. In European countries where constructive skill exists there are no rivers to compare with those on this continent, and the traffic is generally partly at sea, so that the ocean type is about all that is known. Boats on the Danube, Rhine, or Volga rivers, although in some cases called American, are in no respect like any of the types above named. Perhaps the Swedish steamers for inland traffic or around the Scandinavian coast are the nearest approach, being much like our lake propellers—short, high, broad, and with a rolling capacity that comes near reaching a complete revolution. So far as speed and comfort, the Danish coast steamers from Lübeck to Christiana come nearer to an American standard, but the difference is wide. The British idea of a steamboat is a cross between a railway train and an ocean steamer. Perhaps in no country, notwithstanding the great skill in marine engineering, are river boats so little understood. Some of the attempts to supply steamers for the rivers in Asia prove this. Among all types of steamboats those on our Western rivers are *sui generis*—a class that differ from all besides; a compound of awkwardness and adaptability that excites wonder and dread, too, in the minds of foreign travelers. The old and better class of packets have disappeared during thirty years past, and the stern-wheeler, the nondescript among novelties, has exemplified the "survival of the fittest." Railways carry the passengers mainly, and the freight traffic as well as towing is more cheaply done by stern-wheel boats. On this coast they have begun where the Mississippi people left off—that is, have commenced with stern-wheel boats for the Columbia, Sacramento, Colorado, and other rivers, but have, as in other things, followed new methods. The steamers are of the stern-wheel type, and have an outward resemblance to the Mississippi and Ohio boats, but are a refinement on them, and much better built. Adaptation is the ruling characteristic of American engineering practice. Keen perception and a reckless disregard of precedents is to be seen through all, and these Pacific steamboats furnish a good illustration of the result. Fuel is dear, so economy must be looked to in the construction of boilers and furnaces. Speed must also be attained, otherwise passengers would not travel by steamers. There is more depth of water, hence finer lines are followed. The performance of some of the river boats here would astound a Mississippi captain. Think of a boat to carry 500 tons of freight, besides passengers, running at a speed of eighteen miles an hour with one fireman and one engineer, burning a cord of wood each hour. The Wide West, one of the largest boats on the Upper Columbia, will serve as an example. This steamer will carry 550 tons of freight. Her engines are 28 inches diameter, with a stroke of 8 feet; steam is generated in one boiler of the firebox type, wood being the fuel used. The pressure is ninety pounds to a square inch, and the consumption of fuel is only one cord of wood each hour, or, to estimate safely, one cord for each sixteen miles run. This is less than half what would be consumed on the Mississippi with a boat of like capacity. As before said, one fireman and a wood-passer attends to the furnaces, and one engineer with an oiler takes care of the machinery. The steering gear is operated by hydraulic apparatus, and no manual labor is involved in that tiresome task as it is performed on the Western rivers. Think of a man or two men working like mad at a ten-foot steering wheel, with a 500 horse power engine working beneath their feet! In this respect, at least, the advance in naval engineering has been tardy. It is only ten years or so since the first of our transatlantic steamers was provided with steam-steering gear; now all ships of the first class are so arranged, and the wonder is that it was not sooner done. On the Wide West there is the common arrangement of a tiller wheel and ropes connected with their balance rudders. These tiller ropes on their course beneath the cabin floor pass through long hydraulic cylinders of not more than five inches in diameter, the ropes being fastened to pistons that slide freely. If it is desirable to steer by hand no change is required, the water is shut off, and all is ready. The same thing applies in changing to the hydraulic force. The whole is simple, complete, and inexpensive. One strange feature of these boats that will puzzle a Mississippi man is the small size of the wheels. The diameter is not more than two-thirds as great, and the breadth or "face" is also less. This matter is accounted for by the form of the hulls, which have "fine lines" like an ocean steamer, and are not cut "square off," as the Ohio and Mississippi boats. This form of the "run," as they call it, permits the water to flow up to the wheel and "fill it," while with the blunt hulls there is a wide wake left behind for some distance, and the wheel, when it does fill, spends a great share of its power in lifting the water, a force lost in so far as propelling. Of course, wood for fuel and clean water for steam, both wanting on the Mississippi, are important matters in steamboat construction. Nevertheless, there is no doubt, after all due allowance is made, that these Pacific boats are a great advance on the Mississippi type, and that many of the improvements here could be adopted with advantage. There are no boats here to compare with those plying on the Sound and North River. There is no traffic to support such vast steamers, nor are there waterways for them; but in respect to ferries the palm is in the hands of our Pacific friends. The Railway Ferry at Benicia, where the Central Pacific trains are ferried over to complete the short cut to Sacramento, is the largest ever constructed. It is 425 feet long, 116 feet wide, with four tracks, and can carry twenty-four passenger coaches. The boat is driven by two beam engines, 60 inches diameter and 11 feet stroke. The cost was $350,000, a mere bagatelle to this rich, protected corporation, which has just footed up for the present year earnings at the rate

of twenty per cent. on a capital of $100,000,000, called, however, $300,000,000, to make things look better. The ferries on the bay, between San Francisco, Oakland, Alameda, and other points, are sumptuous and complete, having in most cases an upper cabin the whole size of the steamer, fitted up with sofas and sofa seats in a manner that causes even New York people to stare upon their arrival here.

LAURENCE'S CARGO BLOCK.

THE speedy transport of merchandise, whether by land or sea, is a matter of the first importance both to railway companies and shipowners. Every appliance, therefore, by which the handling of cargoes can be facilitated is of value as serving to save the time of ships at the docks, and of the wagons at the railway termini. When heavy Manchester bales or cases have to be dealt with, a considerable time is required for the detaching of hooks and slings; and to effect this the whole time and attention of a man is required at the receiving point. The apparatus we illustrate herewith is an ingenious detaching block, the invention of Captain Laurence, of 8 Fenchurch Buildings, London, who has had much personal and practical experience in dealing with cargoes at sea. This block, which is known as the "instantaneous releasing jaw-block," is formed of two cheeks or plates riveted together through a cast iron arched piece, round which the hauling chain is passed. The chain is kept in its place by a boss or stud, which prevents it coming out of the groove in the block. The end of the chain terminates in a slotted shackle, C, which is passed over the two hooks at the bottom of the block. One of these hooks, A, Fig. 2, is a fixture, while the other, B, is free to swing upon a pin in its upper end. This latter is the detaching hook, while the former may be used for the other end of the sling, and will thus draw the sling away when one end is released. The detaching is effected by a light releasing cord, carried back over the jib of the crane to the man in charge of the crane. This arrangement is shown in Figs. 3 and 4. One essential characteristic of this detaching block is that it may be arranged so that the weight cannot possibly be set free until it is safely landed.

From the detailed illustration, Fig. 1, it will be seen that the detaching or releasing cord is very light, and is attached to the block so that, while the weight is on the fall, the whole weight must be lifted before the releasing action could take effect. When, however, the load is safely landed the weight is taken off the block, which may then be easily lifted and canted, as shown at Fig. 2. By the removal of the strain on the fall-chain, the shackle and swinging link fall perpendicularly by their own weight, and allow the slinging chain to be released. This property of not allowing the load to be detached before its weight is supported cannot be too strongly commended for cargo, as any form of detachment which would allow the load to be released when in mid-air would be highly dangerous.

The especial value attaching to the use of this block is, that the man at the crane can lower away and detach his fall-chain without assistance from any one else. If the slinging chain is jammed round the bale, it may be left behind entirely if it is attached only to the swinging hook; and the transference of the goods may be much facilitated by the use of several slinging chains. When the sling can be withdrawn, one end is attached to the fixed hook, which thus draws the sling away, when the swinging hook is released. In the case of slinging horses on board ship, this block would prove very valuable. The belly-band would be specially made so as to attach to both the hooks, one end to each. The moment the horse was landed on his feet, the belly-band could be released and drawn away clear of the horse.

This block has had a considerable application to cranes and davits for lowering cargo at sea and boats on the Thames Conservancy piers, as in Fig. 3. The boat is detached before she is water-borne, and can be released automatically and instantaneously from the pier. In such cases, the promptitude with which the boat can be detached has on several occasions been the means of saving the lives of drowning persons. For the prompt release of boats before they are water-borne, the releasing chain is made sufficiently strong to be belayed so as to take the weight sufficiently to release the boat before she is water-borne (Fig. 3). In the case of cargoes, it is never desirable to use such an arrangement as would release the goods or bales before they are safely landed, as shown at Fig. 4. We have already, in a former issue, described and illustrated Captain Laurence's patent davits, of which this block, slightly modified, forms a component part; and we understand that these davits have given every satisfaction in their handling at sea.—*Iron.*

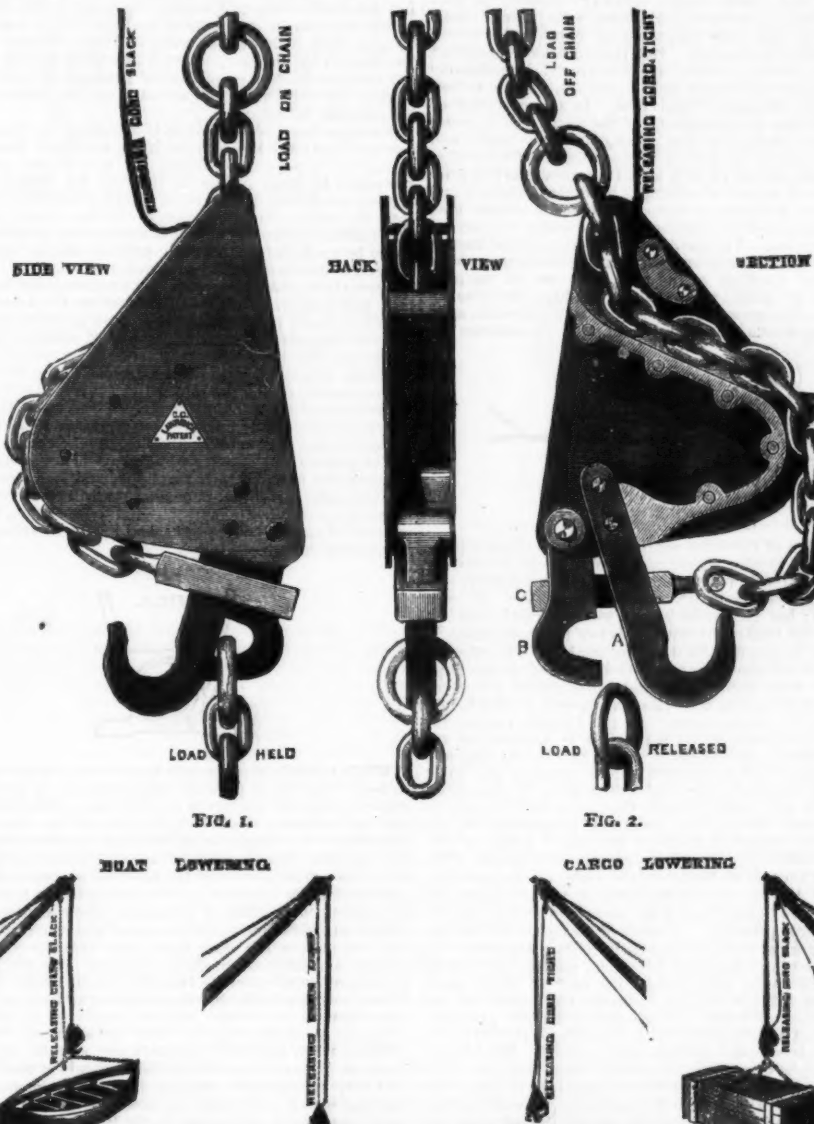


FIG. 1. FIG. 2.

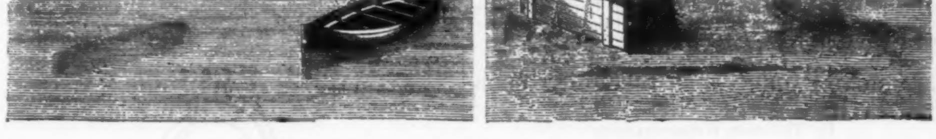


FIG. 3. FIG. 4.

LAURENCE'S CARGO BLOCK.

THE effect of the introduction of the marine steam engine is strikingly shown in the fact that during the century 1600 to 1700 the shipping of the world did not increase. Since that time it has increased tenfold, and has doubled within the last twenty-five years.

TO ESTIMATE THE HORSE-POWER OF A STEAM ENGINE.

By A PRACTICAL ENGINEER.

OF A HIGH-PRESSURE OR NON-CONDENSING ENGINE.

SQUARE the diameter of the cylinder (piston) in inches, multiply the product by 0·7854, multiply this product by the average pressure of steam per square inch on the piston, and multiply this result by the number of feet the piston travels per minute;* divide this final product by 33,000, the quotient will be the *actual* horse power.

As much of this *actual* power is expended in overcoming the friction and other resistances in the engine itself, deduct from the actual power above obtained 20 per cent. allowance for these resistances and losses within the engine, and the remainder is the available power.

OF LOW-PRESSURE OR CONDENSING ENGINES.

Follow the above rule, but to get the average pressure on the piston add to the pressure indicated by the steam gauge or safety valve the pressure of the atmosphere, viz., 14·75 lb. per square inch† (before calculating the average pressure from expansion), to get the total *initial* pressure, and deduct from the result, say, 2½ or 3 lb. per square inch for imperfect vacuum; and from the final result deduct 25 per cent. instead of 20 per cent. (on account of the resistance of the air pump) to find the available power.

A GREAT RAILWAY'S DEPOTS.

WAREHOUSES, ELEVATORS, AND CATTLE YARDS OF THE NEW YORK CENTRAL AND HUDSON RIVER RAILROAD ON THE NORTH RIVER.

"YES, come right along, and I will show you all there is to be seen, and astonish you. Why, we do more business up here in a day than half down town does in a week. Where they send off a cart load, we send off a car load or a ship load, and we do not think we have done anything extraordinary either."

Such was the pleasant greeting given to a *Tribune* reporter by Engineer W. N. Roberts, of the New York Central and Hudson River Railroad, in charge of their immense elevators, warehouses, etc., on the North River.

Few New Yorkers have any knowledge of what activity exists, and what vast quantities of grain, how many thousand barrels of flour and oil and thousands of sheep and cattle are received and shipped at this great depot. The ordinary passer-by would perhaps notice two or three very large buildings, on one of which is lettered "New York Central R. R. and Hudson River R. R. Grain Elevator," and a number of cattle sheds, and pay little attention to them, but if he knew the immense business done there, his curiosity and interest would be immediately awakened. This busy quarter extends along the shore of the North River, from Fifty-ninth to Seventy-second street. Six years ago the Hudson River trains ran at this point right along the river side, and the strong stone wall built to keep the water back may yet be seen, but now it is far inland. Between this wall and the river the railroad company has made a strip of new land about 800 feet in width and in some parts even wider, and on this made ground put up large and imposing elevators, warehouses, and other buildings.

Elevator B is 335 feet long, 70 feet wide, and holds in its 180 bins 800,000 bushels of grain. It is built on piles, which were driven 116 feet below low water mark before they found a hard bottom. They were cut off thirty feet below high water mark, and on them were built stone piers up to ten feet above high water; and on these piers the great elevator stands. It is built of wood and is covered on the outside with galvanized iron for the first floor and slate for all above, to protect it from the weather. The building holds and can empty twenty-two cars at a time, and it takes less than ten minutes to unload a car. The grain is pushed out of the car by a patent shovel and runs into large receiving tanks under the floor. From these tanks in the cellar to the top of the building run numbers of endless belts, and fastened to them at intervals of about a foot are galvanized iron cups, eighteen inches long, five inches wide, and six inches deep, which as the belt revolves catch up the grain and carry it to the top of the building, where they empty it into a hopper, from which it runs through troughs to bins on the floor below holding from four to eight car loads each. The hoppers hold exactly one car load each, and the grain is weighed in them before being sent down to the bins. There are two troughs for each bin, so that while they are receiving grain on one side from the hoppers above, they can at the same time be discharging on the other side and loading vessels in the stream below. The grain is weighed as it is received, and weighed when it is discharged. There are also three large cleaning machines, through which the choice grain is passed and freed from dirt and all impurities before it is delivered.

The bins which hold the heavy weight of from four to eight car loads of grain are not made in the ordinary manner, but are built by piling one on top of another spruce planks, eight inches wide by two inches thick at the bottom, and six inches wide by two inches thick at the top, and riveting them together with strong iron bolts; iron rods running from side to side keep the sides firmly in place, and it is claimed that sufficient weight of grain cannot be put in them to spring them. The machinery is moved by an upright condensing engine of four hundred horse power. It is in a small house adjoining the elevator, and the engine room is so neat and orderly, the engine itself so bright and noiseless, that one wishes to linger and admire it. "It is almost alive," said Mr. Roberts, "and I can stop here for half an hour at any time, and enjoy every movement of it."

Elevator A is now being altered and renovated, and could not be examined. It is built on piles, as was elevator B, but it was not necessary to drive the piles so deep. A hard bottom was found at a depth of seventy-four feet below low water mark. Elevator A is much larger than B, being 354 feet in length, 100 feet in width, and 154 feet in height, and it holds 1,600,000 bushels of grain. "There is no fear of running short of storage room for grain," said Mr. Roberts. "The elevators hold together 2,400,000 bushels, and it goes away about as fast it comes in; but if we should be crowded for space—you see we have a fleet of canal boats in the basin. Well, we can load them and keep the stuff in storage there until we can use it."

At the foot of Sixty-fourth street, just above the elevators, is an immense warehouse, 424 feet in length, 100 feet in width, and two stories in height. It is principally used for

* To obtain the travel velocity of the piston, multiply the number of revolutions per minute by twice the stroke of the piston in feet.

† The average pressures are best obtained from indicator cards. Where these cannot be obtained the results of the estimate of horse power will be only closely approximated.

storing flour. The main floor is used for railroad iron and general merchandise. The barrels are elevated from the first to the second floor by an endless band, turned by steam from the elevator, on which two hooks on a level are placed, with short spaces between them. The band is kept constantly running, and the barrels are rolled on the hooks as they come up from the cellar below, and rolled off when they reach the second floor. The average receipt of flour is now about 100 car loads a day, consisting of about 125 barrels each. They are sent away about as fast as they are received. The flour comes from almost all of the Western States, and is sent to different parts of Europe, but the most of it to England.

NEW PIERS AND WAREHOUSES TO BE BUILT.

But extensive as the arrangements are, the facilities are not sufficient to meet the demands of trade. Twenty-eight vessels were to be seen on one day, a week or two ago, waiting for a chance to load, and yet the men at the elevators and on the piers were doing their utmost, working night and day. This trouble the officers of the railroad company are determined to remedy, and they are putting forth great efforts to hurry up their contemplated additions of warehouses, docks, and piers. Many extensions and improvements have been begun, and others will be begun soon. The railroad company has just obtained possession of an extended line of water front, by a decision of the courts for which it has been looking for a long time, and has promptly begun to fill in and make land. From Sixty-fifth to Seventy-second streets, a line of piers will be built, fifty feet further out than the present shore. The cribs at the water line are already partly built. They are made of logs fastened together, are fifty-five feet deep in the water, fifty-five feet wide at the bottom, and gradually close up together, until they are only forty feet wide at the top. The spaces between the logs are filled in with heavy stones. A few days ago, at about the foot of Sixty-sixth street, where the crib is finished, a big scow was anchored, and a gang of about twenty swarthy, sweating Italians was hard at work throwing heavy stones from her decks in between the logs. A few blocks above two powerful steam dredges were hard at work digging out the mud from the bottom of the river, which is removed to a depth of thirty feet below low water mark, for the foundation of the cribs. It will require about half a million cubic yards of material to fill in the space behind the cribs and make the needed new land. From these bulkheads, when completed, six new piers will be built of the same size as those now in use.

It will take, it is calculated, about two years to complete this great work. There are now nearly 200 men engaged on it. A contract has just been given to E. G. Brown to build a new warehouse, somewhat similar to the one now in use. He is to have a large force of men busy on September 15 next, and will deliver the building finished to the railroad company October 15. Estimates are also now being received for an immense warehouse at the foot of Fifty-ninth street. It is to be built of wood, 300 feet in length and four stories in height, and is intended principally for storing lard, though when not full of that it will be used for general merchandise. A new engine house is to be built, capable of holding forty locomotive engines, the demand being so great that it is now necessary to have the engines on hand so that they can be used without delay.

A GLANCE AT THE GREAT STOCKYARD.

Passing from the grounds of the New York Central and Hudson River Railroad, one's attention is attracted by the large stockyard. Eleven acres of ground are covered by its stalls, sheds, and pens, and about 5,000 cattle are received each week; but that number is far below the receipts in cold weather. The cattle come from Chicago, and they reach Chicago from all parts of Illinois, Iowa, and, indeed, from all the Western States. They arrive here tired and excited, but they are so carefully handled when they get to the stockyard that the deaths from heat and exhaustion have been less this year than in any previous year. The Texas cattle are the toughest looking of all, and it seems impossible to fatten them. A man comes with every cattle-train who is supposed to feed the animals every twenty-four hours, to give them water frequently, and at every stopping place to examine every car to see if any poor beast is sick or needs attention. Whether he does all this is a mooted question, and judging from the appearance of some of the cattle when they arrive, the duty is not always well performed. When they arrive at the stockyard the cattle are fed and watered moderately at first, but afterward they are given one big feed of hay a day and all the water they want. They consume and waste about 60,000 gallons of water a day.

The cattle market opens about dawn on Mondays, Wednesdays, and Fridays, and the business is practically finished by 9 or 10 A.M. The buyers generally send the cattle to the slaughter houses at the foot of Forty-fourth street, East River, and to Fortieth street and Eleventh avenue, or to other slaughter houses, and from them the beef is taken to the stands of the wholesale dealers, and sold to the retail butchers of New York, Brooklyn, Jersey City, Hoboken, and other places near by.

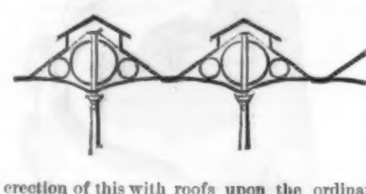
Sheep bear the hot weather well, and there are very few deaths among them, sometimes not one a week. About 12,000 sheep arrive each week at present, but in September the average probably will be 30,000 a week. They come from Ohio, Kentucky, Illinois, and the West generally, and most of them are killed in or near New York. A car-load now consists of from 200 to 240, because they have been sheared and do not take up much room; but in the winter, when they have on their heavy coats, a car will hold only about 150. The "sheep-house" can contain about 14,000 sheep.

The grounds for the cattle and sheep being directly on the banks of the Hudson River, where if any breeze is blowing they are sure to get it, and being far away from all factories and noisome smells, are very well adapted to the purpose for which they are used. The animals improve in condition rapidly when they are penned where they can lie down comfortably and get enough to eat and drink. But most of the pens have no roofs over them, and so the poor beasts are kept in the sun all day. A few dollars for rough planks for roofs would be well expended, and to build them would be an act of humanity, not only for the sake of the cattle, but also because firm healthy meat is desirable for the table.—*N. Y. Tribune.*

A REVIVAL of the ancient Greek drama, similar to the one at Oxford last year, will be attempted at Harvard College next spring. The play to be presented is the "Œdipus Tyrannus" of Sophocles. Mr. George Riddle, a graduate of Harvard, will assume the principal part and have entire direction of the work. It will be performed at Sanders Theatre, where the regular commencement exercises are given.

GREAT SPAN ROOFS.

OUR engineers are beginning to learn that the larger the roof the more intractable it becomes. It is more costly to erect, difficult to repair and paint, it occupies greater height, and is generally attended with more risk. The St. Pancras roof, a combined work of engineering and architectural skill, affords us an example of one of the finest, in this country at least; but although it springs from the platform, it rises to a height, and presents an external appearance that is, perhaps, less satisfactory, than flatter curves. A large roof, as we generally understand it, is a single span, springing from the walls and meeting at a point at the ridge. Such a form of roof necessitates considerable height of ridge, and the roofing-in of a large space. Paxton, in his ridge-and-furrow principle of roofing, taught us that a great space might be covered on a different principle: by, in short, a series of small-span roofs, and the Crystal Palace exemplified the system as one of decided economy for large buildings. Recently engineers have learnt the value of an economical principle in construction, namely, that the multiplication of small and simple elements is often more desirable than one large and complex structure; and that in repair and cleaning the former system has unmistakable advantages. Just now the ridge-and-furrow system, on a large scale, is being adopted at Carlisle, over the new station now erecting by the London and Northwestern Railway Company at that city. The roof is a series of small-span roofs, placed transversely to the line, and supported by open trellis-braced girders of light construction. But these girders, instead of being placed wholly below, are introduced immediately under the ridges which they help to sustain, and the rafters and valleys are suspended from them. In a construction of such a kind thrust is eliminated, and the whole roof becomes a succession of straight girders resting upon the walls, and supporting a series of gutters between them. Practically, the advantages offered in such a roof are great, curved principals are saved, height of walling is minimized, there is less weight of iron, and each cross roof becomes a simple one, quite independent of its neighbors, and capable of easy repair and attention. The Carlisle roof covers several lines of rail, and the open girders are placed at a good height above the platform. Looking at the roof from one of the platforms, or, as we should technically say, taking the longitudinal section, the appearance presents a series of roofs, as in the following sketch. It would be of value to compare the



cost of erection of this with roofs upon the ordinary plan, and the cost of repair and painting would be an interesting item. At the Glasgow terminus of the Central railway station, a roof of similar construction is to be seen of even greater span; but the trellis-braced girders which rest on the walls of the station are entirely below the roofs, which in this case run longitudinally with the station. The effect is obviously less satisfactory viewed from the end, as the large cross braces, with their upper and lower flange pieces or booms, arrest the eye at intervals, and there is greater height occupied by the arrangement. At the Carlisle station, the continuity of the roof in its main axis is assisted by the light open circles and cambered ties shown in our diagram, if we can really call them such, which connect the great cross girders longitudinally, and stiffen them in that direction. These are nothing more than spandrel bracings to carry the cross gutters, but they help greatly also in the effect. At the ridges of the roofs are raised lights, or louvers, for ventilation. One of the greatest advantages of the roof is, that there is no thrust on the walls; on the contrary, it tends to tie them together; there is no lost space; the walling may be lighter than with roofs constructed on the arched or bow principle. A span of 80 feet to 90 feet was considered a great engineering feat in roofing when first iron was employed, and the great Liverpool station roof of 153 feet, or, still more, the joint-station roof of New street, Birmingham, 212 feet in span, spanning ten lines of rail and four platforms and roads, constructed on the bow principle, with cast iron arched girders with cross diagonals and struts, appeared to accomplish all that was required. But, though grand triumphs of constructive architecture, they have their defects, which the ridge-and-furrow principle in a large degree removes. The Italian Opera House, Covent Garden, was one of the first buildings in which the principle was applied, the spans in this case being carried by a series of double trellis girders 9 feet deep and about 20 feet apart, but they were placed below the gutters. In the Carlisle example the space is still further minimized, and the architectural effect rather improved.—*Building News.*

ELECTRICAL MACHINES—AN IMPORTANT PROBLEM AND ITS SOLUTION.*

By THEODOR WIESENDANGER.

THE powerful impulse given to scientific research and inventive effort by the rapid progress in the development of the electric light during the last two years, has produced the most promising results with regard to the production and employment of powerful electric currents for practical useful purposes. In these results, as already achieved, the scientific mind cannot fail to detect the embryo of a grand system of production and transmission of energy through conversion of forces, which is to supersede in times to come the means and methods at our command in the present century for generating motive energy through combustion. Remote as the date may be when the vast accumulations of coal which now serve to impart life to our prime motors shall all be consumed, and the mines all exhausted, yet that epoch will and must come, as surely as our supply of combustible fuel is limited, as surely as we now consume the light and heat producing carbons in a manner both wasteful and thoughtless. Numbers of coal mines in this country are already abandoned, their resources being exhausted, and when the last of them is delivered up to that destruction which is brought about by time, wrought by oxidation, slow and sure, nay, before that time has come, a grand problem is to be solved. Science must then have discovered new principles, invented new methods and novel appliances, able to supersede the agencies at work in the present era, to cheer our homes with light and heat, to supply us with the vast motive energy that animates the thousand living mechanisms of our industries and factories.

Perhaps it is natural that our present generation should find it difficult to di-associate the idea of generation of caloric, luminous, and motive energy, from that of combustion, the rapid oxidation of fuel, and that the solution of the problem spoken of above is sought merely in the substitution of the consumption of carboniferous matter by that of some other substance.

A change more thorough is, however, to be wrought. There are powers at our command already by means of which motive energy, light, and heat, can be excited and transmitted to considerable distances, and the scientific mind has found indications, sure and true, which create a conviction that, as the secrets of these forces are investigated and more and more brought to light, so the transmission of heat as well as that of luminous and motive energy will no longer be limited by space. Electric currents of almost any power can be, and are now, both naturally and by artificial means, produced independently of either slow or rapid oxidation. The friction created by wind and water, the action upon each other of different parts of the globe, unequally heated, excite powerful currents of electricity unknown to and left unemployed by the human race. The tides that sweep our shores and ascend our rivers are another grand creative source of motive energy, unlimited, unexplored, and idle. Let this fertile source of energy be utilized, the difficulties in our way can be surmounted, and the energy thus obtained may, with little loss, be converted into electric currents less limited by distance, currents powerful enough to melt our steel, to illuminate our public promenades and streets, to plow our very fields, and animate the iron sinews of our innumerable factories.

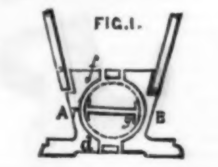
Attempts have been made in this country to transmit the power of a waterwheel, driven by a waterfall, through the agency of conversion of forces. A well-known gentleman succeeded by these means in lighting his library, and in driving machinery stationed at a very considerable distance from the prime source of energy. It was found, however, that further researches and new discoveries and inventions are to be made before the same process can be extensively applied to practical useful purposes.

Since then a similar project, but on a scale far larger, has been undertaken, and is being carried on in America, and should it finally prove a success it is proposed to employ the Falls of Niagara as the central source of motive power for all the neighboring country.

All the results hitherto obtained point to the fact that one of the greatest difficulties met with in this field of work is the inefficiency of the dynamo-generators, and especially of the electro-motors of our present time, together with our as yet imperfect and fragmentary knowledge of electrical energy.

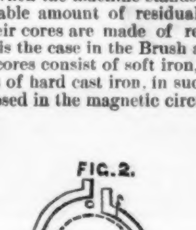
The greater the number of improvements made in the construction of the former machines, and the more deeply our scientific investigators penetrate into the secret of this subtle force, the less remote will be the time when the transmission of motive power, light, and heat, will triumph over its greatest enemy—distance.

FIG. 1.



While recently many minds have been at work with more or less of success to produce improvements in dynamo-generators of electric energy, a very few have given their special care and attention to the development of the electro-motor. Experience has taught us hitherto that the efficiencies of one and the same machine for action and reaction, or for use either as a generator or by the inverted process as an electro-motor, stand in a certain and direct proportion to each other, or that our most efficient generator, such as the Siemens, Brush, and Gramme machines, prove also the most effective motors; and, on the other hand, that inferior dynamo machines invariably are inefficient motors. It would, however, be hazardous to conclude from the results of the researches I have recently made that the motors which are to supersede those now in use could not be employed as generators. Dynamo machines, such as now constructed, only prove efficient when their field magnets are able to retain at all times (*e. g.*, even when the machine stands at rest) a certain and very considerable amount of residual magnetism, and for that reason their cores are made of retentive material, hard cast iron, as is the case in the Brush and Gramme machines; or, if the cores consist of soft iron, they are attached to large masses of hard cast iron, in such a manner that the latter are inclosed in the magnetic circuit and form part of the cores.

FIG. 2.



Generators of the same kind, when made small in size, have cores much larger and heavier in proportion, and, moreover, the base plate, or, as in the Weston machine, a heavy retentive cylinder is made to form a portion of the field magnets. But all effort hitherto made to produce efficient small dynamo machines, with cores of soft iron only, have resulted in absolute failure, although men of the highest genius have made repeated and prolonged efforts to solve that most difficult of problems.

These curious facts conclusively prove that the theory explanatory of the action of dynamo machines, as now universally adopted, viz., the theory of inductive action and reaction between the field magnets and the armature, cannot any longer be considered complete or satisfactory; for even wrought iron, especially when occurring in large masses, always contains an appreciable amount of residual magnetism, more especially after it has once been subjected to strong magnetization; and if the above theory were correct and complete, then the smallest possible amount of residual magnetic energy, augmented by repeated action and reaction,

* A paper read at the late meeting of the British Association.

would be sufficient for the starting of such a machine to action. This, however, experience proves *not* to be the case, and the theory, although stoutly adhered to, must be either abandoned or amended.

FIG. 3.

The inventors of the most recent electromotive engines have worked—perhaps, unconsciously—upon the idea that the construction and action of electro-motors are based altogether upon the same laws as those of dynamo or magneto machines, and, in accordance with that assumption, the field magnets of the Desprez motor are made to consist of large and heavy masses of magnetized steel.

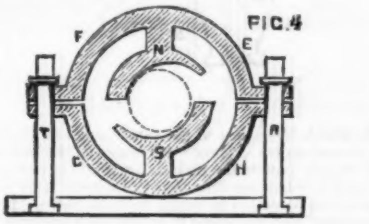
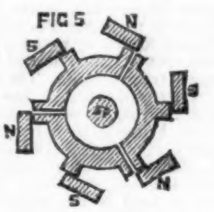


FIG. 4

Experiments have also for a long time past clung to the idea that the efficiency of an electro-motor, or the amount of energy to be obtained from such a machine, by means of a current of given strength circulating in the coils of its armature only, bears a definite and direct proportion to the magneto-inductive power of its field magnets, and that an increase of power in the field magnets alone must necessarily produce greater capabilities of the machine.

FIG 5



This is a mischievous theory, because erroneous in some principles, and development would only lead to the hypothesis of perpetual motion. On the contrary, starting from a consideration of the fact that a very small magnetic needle, if acted upon by one of the poles of another and very powerful magnet, has its polarity destroyed or reversed, and that if one of its poles, say the N pole, is presented to a similar (N) pole of the large magnet, the former will completely lose its characteristic qualities, and be attracted by its overpowering opponent, we can only come to the one natural conclusion, that the power of the field magnets of an electro-motor, as compared to that of the magnet or magnets constituting its armatures, should not surpass the limit of some certain ratio, to be determined by experiments carefully conducted, and that, if it surpasses that limit, the capabilities of the machine must be impaired. Acting on this principle, I have constructed a motor in which the power of the field magnets is as nearly as possible equal to that of the armature, the core of the former being very light and made entirely of soft iron, and the satisfactory results I obtained from this machine are a sure sign that further investigation of the subject and experiments made with a view of determining the exact ratio of power between the magnets and armature, will result in further improvement.

Another and very important consideration in the construction of dynamo machines and electro-motors has not yet received that care and attention from scientific investigators which would lead to immediate progress. It is the method of motion of the revolving armature with regard to its approaching to or receding from the poles of the field magnets. In nearly all the machines now constructed, the polar faces of the cores of the field magnets, and those of the armature, are of such a shape, and the latter is caused to revolve in such a manner, that only in a small portion of the revolution its poles either approach the poles of the field magnets, or recede from them. But the most successful production of induced currents will be achieved, and the greatest amount of power will be derived from a motor, if attention is paid, not merely to the *one* condition, that the armature should revolve in the most highly concentrated field possible, but also that nearly the entire motion of the revolving armature should be either one of approach or of withdrawal.

Let us first of all consider the case of a machine with two poles only of field magnets, and two poles of the revolving armature.

It is usual to give the active *facial* of the former such a shape that a section of the same represents a portion of a true circle. (See Fig. 1.)

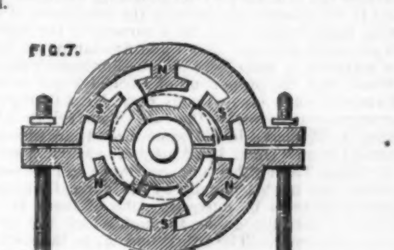
In the ordinary machines now in use, the radius of the circle described by the outline of the revolving armature, and that of the larger circle described in portion by the section of the inner or active *facial* of the poles, are nearly the same, and the two circles are concentric. (See Fig. 1.) The pole, *g*, of the armature only approaches the pole, A, of the field magnets while moving from *c* to *d*, or where the intensity of the magnetic field of A is at its minimum. When continuing its motion from *d* to *r* and to *f*, the pole, *g*, can no longer be said to approach A, because the distance between the respective surfaces remains constant.

I, therefore, propose that the device shown in Figs. 2 and 3 should be adopted. The radius of the circle, part of which is formed by the section, *d r c*, is considerably larger than that of the circle described by the outline of the field of motion of the armature, *d r c*, is, moreover, considerably less than the half of a circle, and the three circles, *d r c*, *f*, *c h*, and that described by the outline of the field of motion of the armature, are not concentric. The pole, *g*, of the armature when in motion approaches the pole, A, not only in its course from *e* to *c*, but also when in the most intense magnetic field of A, viz., while moving from C to *s* and *d*. Fig. 4 represents a section of the field magnets, cores, E F and G H, and pole pieces, N and S, cast in two halves, and mounted on a base board, to which they are fixed by the two bolts, R and T. The same principles may be applied to machines with field magnets of more than two poles (see Fig. 5), or the armature itself may be made of such a shape as to work

FIG 6

under the conditions above stated. (Fig. 6.) But even if the poles of the armature and those of the field magnets are one of the ordinary shape, a machine with many magnets will be more perfect in its action than one with field magnets of two poles only. Fig. 7 illustrates a machine in which the armature during nearly the whole of its motion either approaches to or recedes from the poles of the field magnets. In such machines the motion of the poles of the armature is also more in a line coincident with the line of attraction as exercised between the two systems of poles, while in machines with field magnets of two poles only the motion of the poles of the armature is at times at angles of 45° to 1° from the direct pull.

FIG. 7.



I may, perhaps, be allowed to call attention to another matter of importance awaiting further research. We find that in the three types of dynamo machines, as constructed by Siemens, Gramme, and Wilde, the relative positions of the axes of the field magnets and those of the armatures are altogether different. Yet the three systems work well. We are unable, however, to state with certainty which positions of the axis are the best, or why any one of these positions should be better than the others, and in the face of experience, the theory of tubes or lines of force is little more than a hypothesis with all its diffusion, vagueness, and uncertainty.

Having so far considered general principles chiefly, I now describe this motor (Fig. 8). A B C D is a wooden base board, E F G H a frame, consisting of the two parallel round rods, F E and G H, and the two flat bars, F G and E H, made of the best wrought iron and carefully softened. The four bars are screwed together at the corners and supported by four brass brackets over the base board. These four iron rods form the compound core of the field magnets, a combination, as it were, of two horseshoe magnets, whose similar poles, S S and N N, form the junctions. Thus we have practically two poles only, a S and a N pole. Six coils of insulated copper wire are wound over the different portions of this core, shown in the drawing; the active pole pieces are left exposed for a long distance, bearing no coils. The spindle, T L, which carries a Siemens armature of the old form, or an armature with a compressed tubular core, the commutator and pulley, traverses the flat cross bar, F H. The core of the armature is made of sheets of charcoal iron, and it bears a coil of stout insulated copper wire. The commutator is of the ordinary kind, consisting of two half tubes of brass insulated from each other and from the spindle, and each forming one of the terminals of the coil. Other diagrams were referred to, showing a sectional view of a compound machine and a view of the two end castings which hold the field magnet, acting on the same principles. This machine contains a system of six field magnets and six poles, and a compound armature with six poles. The current is to be reversed six times for each revolution, and to accomplish this I have devised the following commutator. In these machines also the poles of the field magnets or those of the armature may be of such a shape as to be nearly always approaching to or receding from each other while in active motion.

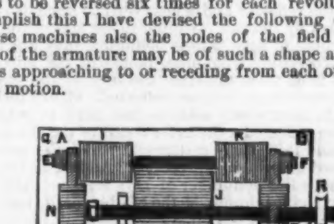


FIG. 8

The development of most important machines is destined to reach a certain stage of perfection when further improvements cannot be accomplished by the inventor unaided; the second and important factor needed, then, is the co-operation of inventive and investigative talent with capital. This stage of perfection has been reached in the steam engine, gas engines, printing machinery, etc., and it may be said to be rapidly approached by the progress made in dynamo machines and electro-motors.

The development of the latter machines is followed by the scientific world with greater interest, and it evokes more eager expectations than that of other machinery, chiefly because it is not and cannot be identified with the solution of a problem limited within the confines of mechanical difficulties and commercial interests; but it necessitates a further and deeper investigation into that great and subtle power—electricity—whose manifestations are so striking in their effects, so mysterious in their nature, so promising of great results in an immediate future, so fertile a field of research to the pioneer of science. Combined with this is the interest which of necessity must be attached to the efforts at the solution of a national problem, nay, one of international and universal moment, and one at which our ever active transatlantic kinsmen have worked to so great credit. Who will be the winner in this meritorious competition? Of higher moment even than the answer to this question ever can be is the consideration that by the work done in trying to solve the great problem new efforts will be made in scientific research, new principles discovered, new inventions made, and more light will be thrown over fields of intellectual work hidden, even now, in darkness, doubt, and mystery.

PHOTO-ELECTRICITY.

By GEORGE M. MINCHIN, M.A., Professor of Applied Mathematics in the Royal Indian Engineering College, Cooper's Hill.*

1. *Two Objects of Photo-Electricity.*—In the study of the electric currents produced in various ways, by the action of light, I have had two objects in view, viz.:

(I.) The production at a distance of effects due, in the first instance, to the photographic action of light; and

(II.) The continuous daily registration of the intensity of sunlight of any selected wave length.

It is at the outset evident that for the solution of the latter problem, the action of the light whose intensity is to be measured and registered must be received on some substance whose chemical composition is either unaltered by the light, or so slowly and slightly altered during the period of observation that the magnitude of the change may be neglected.

For the solution of the former problem it occurred to me, in the first instance, to receive the photographic action on plates coated with the silver salts in ordinary use among photographers; but I do not now think that it would be necessary to work exclusively with these substances, and if the use of them can be to any extent dispensed with, a corresponding gain would apparently result, since they are permanently and very rapidly decomposed by luminous action.

2. *Luminous Action a Source of Electricity.*—It has been long known, from the experiments of Becquerel and Grove, that electrical currents can be produced by the action of light. Becquerel took two clean silver plates, exposed one to the vapor of iodine, plunged both into a cell containing a feebly conducting liquid, and completed the circuit through a galvanometer. The cell being completely covered up, the moment the circuit was completed, a strong current was set up. This current disappeared after about twenty-four hours. Then, on illuminating the sensitized plate, an intense current was generated by the light.

Grove used a prepared Daguerreotype plate inclosed in a box filled with water, having a glass front with a shutter over it. Between this glass and the plate was placed a gridiron of silver wire, and, on completing the circuit through a galvanometer, a current was generated by the action of light on the Daguerreotype plate. (See the "Correlation of Physical Forces.")

Grove also found that when two clean platinum plates were immersed in a cell containing acidulated water, and one of them was exposed to light, a current was produced. Before the light was allowed to fall on the plate there was, of course, the current which is always produced by the immersion of two plates, however similar we may succeed in making them, in any liquid. This current I shall in the sequel speak of as "the disturbing current," since it is produced by some other agency than that of light; and I shall frequently refer to it as the "D. C.," for shortness. The current produced by the action of light on one of the platinum plates was found by Grove to be always in the same direction as that of the D. C.; and he found, moreover, that the current produced by blue rays was greater than that produced by red.

Currents of this latter kind may be produced by the agency of light in several different ways. For instance, the two platinum plates will give the current in question if they are immersed in common tap water. Again, the two clean platinum plates may be replaced by two clean silver plates, and we shall obtain still stronger currents by the action of light on one of them. No doubt several other metals would be found to give similar results.

All such currents—viz., those generated by the action of light on any unsensitized metallic plate immersed in a liquid, in presence of a similar plate unexposed to the light—I shall in the sequel designate as "Grove's currents." They are exceedingly small compared with the photo-electric currents with which we shall be occupied.

3. *Plates Employed.*—Since the substances to be acted upon by light were, in my first experiment, salts of silver, I chose silver plates in order to avoid as much irrelevant action in the cells as possible. At first the plates were simply stiff pieces of silver foil, about two or three inches long and one or two inches broad; but it appeared at least possible that much of the current was lost by passing from the coated (or sensitized) side of a plate round to the back of the same plate; and for this reason, after having already performed several experiments, I tried the effect of insulating the back and edges of the plate by a thick layer of shellac varnish. The result was a greatly improved action, and this finally led me to fix the silver foil by means of pitch to rectangular pieces of glass. Thus the back of the plate was completely insulated. For the purpose of making the connections a piece of thin silver wire, about two inches long, may be welded to the upper edge of each strip of silver foil before it is fixed to the glass plate; but binding screws will do, if care is taken to keep the portion of the silver plate which they touch from contact with the liquid in the cell.

Fig. A shows the arrangement of the two plates in the cell. The plate coated with the silver salt, or other substance to be exposed to light, is S. It stands in a rectangular glass cell in contact with one of its faces; slightly to the side of S, and in contact with the opposite face of the cell, stands the unsensitized plate, U. In the figure we are looking at the back of U; and the whole of the cell, with the exception of the portion directly in front of the sensitized plate, ought to be covered with black paper, to prevent the access of light to the unsensitized plate.

4. *Notation Employed.*—We shall have such frequent occasion to refer to the sensitized and unsensitized plates—mean-

* Read before the British Association.

ing, respectively, the plate coated with the substance to be exposed to light, and the plate uncoated—that we shall, for shortness denote them by the letters S and U. As already stated, any current produced by agency other than that of light will be denoted by D. C.

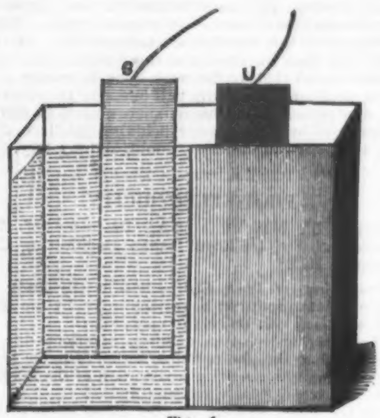


Fig. 4.

5.—*Disturbing Current.*—It may be well to state at once that the D. C. varies, both as to duration and to direction, in an irregular manner, and that Grove's observation, to the effect that its direction is always the same as that of the current generated by light in his experiments, is not true with regard to photo-electric currents generated in other ways.

6. *Chloride and Bromide of Silver.*—If an emulsion is formed by shaking up in a test tube a little finely powdered chloride of silver mixed with collodion (the test-tube being, of course, completely screened from light by a covering of black paper), a silver plate coated with it in the dark, immersed in presence of an uncoated plate in a cell containing distilled water and a few grains of common salt, will, when exposed to light, give rise to a current, the direction of which is

from U to S in the cell.

If the liquid employed is dilute H_2SO_4, the same result follows, and apparently the current is of the same magnitude.

Sunlight (dull) is quite sufficient to give the current, and the deflection of the spot on the scale will be observed to rise or fall according as the intensity of the incident light increases or diminishes.

I have also tried the experiment by using the light of a candle placed at different distances from the cell, and each distance of the candle produced a corresponding deflection of the spot.

The effects of light of different colors were studied by interposing colored glasses in the path of the incident light, and it was found that, while the effects of blue and violet rays were very great, the red rays gave a hardly appreciable effect. Light falling on the plate after having passed through a thick cell containing a dense solution of ammonia sulphate of copper gave also a large deflection. The galvanometer used was a Thomson reflecting galvanometer, of about 7,000 units resistance; the screen was usually placed at a distance of about a yard from the mirror; and a piece of burning magnesium ribbon, held at a distance of a foot from the plate, would cause a very rapid motion of the spot off the screen.

The plate may be coated with an emulsion of bromide of silver made in the same way, but I have preferred to use the well-known "Liverpool emulsion." In this case the liquid in the cell was usually distilled water, with a few grains of bromide of potassium.

The current appears to be of about the same strength as in the case of the chloride cell, and the direction is still from U to S in the cell.

It is scarcely necessary to say that chloride and bromide plates must be prepared in a photographic dark room.

I have not systematically kept a note of the direction of the D. C. with these plates, but I have noted some instances at least in which it is opposite to that of the photo-electric current.

7. *Iodide of Silver.*—Let a silver plate be coated, in the usual way, with silver iodide, by first pouring a layer of iodized collodion over the plate, and then immersing the latter in a nitrate of silver bath. If the liquid in the cell is distilled water, with a few grains of iodide of potassium, it will be found that the direction of the photo-electric current is

from S to U in the cell,

that is, opposite to the direction of the chloride and bromide currents.

8. *Nitrate of Silver.*—A solution of silver nitrate was mixed in a test tube with rather thin gelatine, and a silver plate coated with the mixture was immersed, in presence of an uncoated plate, in a cell containing distilled water and a few grains of nitrate of barium. D. C. from U to S in cell, rather strong, and of very long duration. Light falling on the plate gave a comparatively small result.

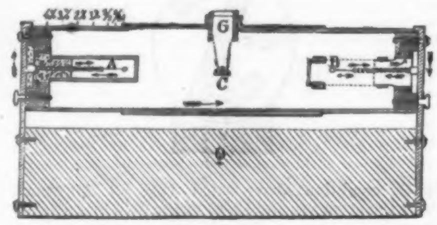
The plate was then further washed over with the silver nitrate solution, and there was an improved result. The cell was connected up with the galvanometer all night; and next day, the spot having come to rest at two hundred and fifty divisions of the scale from the zero (which was its position when no current passed), magnesium light was used with great effect.

When no glass was interposed, the spot moved a long way off the screen in the direction opposite to that of the D. C. With an interposed blue glass the current appeared to be nearly as strong as when no glass intervened. An interposed red glass gave a very small current indicated by a motion of only ten divisions in the opposite direction. From such a small motion, however, no conclusion can be safely drawn, for the current may be only a Grove's current.

Professor Minchin further described the "Photographic Effect of Current," "The Action of Light on Current," and other interesting phases of his subject.

AN ELECTRICAL FIRE-DAMP PHOTOMETER.

Hitherto there has existed no really practical apparatus for ascertaining at any instant the amount of explosive gases contained in the atmosphere of coal mines. There has been no want of instruments which, according to their inventors, would effect the object, but all have failed when put to the practical test. Recently, Mr. E. H. Liveing has brought to the notice of the Physical Society of London a device which, it is claimed, solves the problem satisfactorily. In this apparatus, called the fire-damp photometer, the inventor has utilized the resources both of physics and chemistry. He uses the electric current for causing the combustion of the fire-damp, and then compares the luminous intensity by means of a very ingenious photometric arrangement.



In the construction of his apparatus Mr. Liveing has taken advantage of the following fact: If a platinum wire be made red-hot by the passage of an electric current, the incandescence will be brighter in a mixture of air and fire-damp than in pure air, and the brilliancy will increase in proportion with the increase of the fire-damp. It will be readily seen that if we choose as means of comparison the brilliancy of incandescent platinum in pure air, and if we observe successively the brightness of a platinum wire, made incandescent by a current of the same strength, in prepared mixtures of air and fire-damp, we shall be able to establish a ratio between the luminous phenomena observed and the proportion of explosive gas in a mixture. To render such comparisons easy, Mr. Liveing adopts the arrangement shown in the cut. Two spirals of platinum wire, A, B, placed in the same circuit, are traversed by the current from a small hand magneto-electric machine. The two wires, having the same resistance and the same cooling surface, are heated equally by the current, and exhibit the same brightness in pure air. One of them, B, is inclosed within a metallic gauze, through which the air from the mine can enter. The other one, A, is inclosed in a brass tube containing pure air. At their extremities both tubes are closed by a piece of glass. To measure the differences of intensity of light in the two spirals, Mr. Liveing has devised a very simple photometer, composed of a wedge-shaped screen, C, the sides of which are made of oiled paper, and which receive the rays from the inclosed spirals. These two inclined planes are viewed through the tube, G, which, as well as the screen and outer tube, can be moved longitudinally. In using the apparatus, the outer tube, which is graduated, is pushed out or in until the luminous intensity of the two screens is equal. The proportion of fire-damp contained in the mixture submitted to experiment is then shown by the graduation on the tube. The difference in brilliancy produced by the combustion of certain definite mixtures is given by Mr. Liveing in the following table. It is well to state that these results appear to be independent of the speed of rotation of the small electrical machine employed:

Proportion of C_2H_4.	Comparative Brilliancy of the Spirals.	
	Closed Tube. Pure Air.	Metallic Gauze. Mixtures.
Pure Air	1	1
0·25 per cent	1	1·21
0·50 "	1	1·65
1 "	1	2·78
2 "	1	5·10
3 "	1	22
4 "	1	64

THE HELIOGRAPH.

IMPROVED HELIOGRAPH OR SUN SIGNAL.*

By Tempest Anderson, M.D., B.Sc.

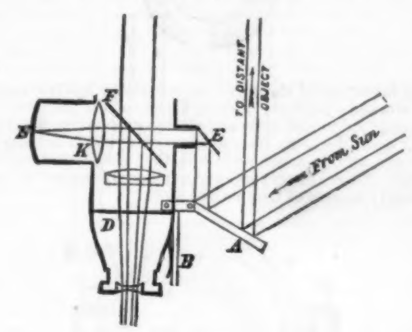
The author claims to have contrived a heliograph, or sun telegraph, by which the rays of the sun can be directed on any given point with greater ease and certainty than by those at present in use.

When the sun's rays are reflected at a small plane surface considered as a point, the reflected rays form a cone, whose vertex is at the reflector and whose vertical angle is equal to that subtended by the sun. Adding to the size of the mirror adds other cones of light, whose bounding rays are parallel with those proceeding from other points of the mirror, and only distant from them the same distance as the points on the mirror from which they are reflected. Hence increasing the size of the mirror only adds to the field to which the sun's rays are reflected a diameter equal to the diameter of the mirror, and this at any distance at which the sun signal would be used is quite inappreciable. Adding to the size of the mirror adds to the number of rays sent to each point, and hence to the brightness of the visible flash, but not to the area over which it is visible.

By the author's plan, an ordinary field glass is used to find the position of the object to be signaled to, and to it is attached, in the position of the ordinary sunshade, a small and light apparatus, so arranged that when the mirror is turned to direct the cone of rays to any object within the field of view of the glass, an image of the sun appears in the field, at the same time as the image of the distant object, and magnified to the same degree, and the part of the field covered by this image is exactly that part to which the rays are reflected, and at which some part of the sun's disk is visible in the mirror.

A perfectly plane silvered mirror, A, takes up the rays of the sun, and when in proper position reflects them parallel with the axis of D, which is one barrel of an ordinary field glass. The greater part of the light passes away to the distant object, but some is taken up by the small silvered mirror, E, which is placed at an angle of 45° to the axis of D, and reflected at a right angle through the unsilvered plane mirror, F, and the convex lens, K, by which it is brought to a focus on the white screen, H, which is placed in the principal focus of K. The rays from this image diverge in all directions, and some are taken up by the lens, K, and restored to parallelism; some of these are reflected by the unsilvered mirror, F, down to the field glass, D, and if this is focused for parallel rays, as is the case in looking at distant objects, an image of the sun is seen projected on the same field of view as that of the distant object.

As the mirrors, E and F, are adjusted strictly parallel, the rays proceeding from F into the field glass are parallel and in the opposite direction to those going from the mirror, A,



to E, which form part of the same pencil as those going to the distant object. Hence the image of the sun seen in the field exactly covers the object to which the sun flash is visible, and in whatever direction the mirror, A, is moved so as to alter the direction in which rays are reflected to the distant object, and the angle at which part impinge on E, and are reflected through the lens, K, the image visible in the glass moves in the same direction. Several attempts to produce this result were made by the use of mirrors and prisms, before the lens, K, was introduced, but they all failed. It was easy to make the image of the sun cover the object when the two occupied the center of the field of view, but directly the mirror was inclined so as to direct the rays not strictly parallel to the axis of the field glass, the apparent image diverged generally in the same direction along one coordinate, and in the opposite along one at right angles to it, so that nowhere but in one line across the field did the image lie in the desired position. The mirrors, E and F, are adjusted parallel once for all, by noticing the position on a screen of the small spot of light reflected from the front of F, as the light passes from E to K. The mirrors are moved by the adjusting screws till this spot has, to the bright reflection from the mirror, A, the same relative position that the center of mirror, F, has to the mirror, A.

In actual use the field-glass is first fixed in position pointing to the object, either by holding steadily in the hand, or better by a clamp attached, by which it can be screwed into a tree or post, or fixed in the muzzle of a rifle. The instrument is turned on the barrel of the glass till the sun is in the plane passing through the two axes of the instrument, and the mirror, A, is turned till the bright image of the sun is seen on the screen, H, through a hole left for the purpose in the side of the tube. On looking through the glass the sun's image is seen, and by then slightly rotating the instrument, or moving the mirror, is made to cover the object. The mirror, A, is connected not directly to the body of the instrument, but to a lever, B, on which it works stiffly, so as to retain any position in which it is placed. Lever, B, works easily, and has a limited range of motion, to one end of which it is pressed by a spring; slight pressure with the finger moves it and its attached mirror, so as to throw the light on and off the object in a succession of long and short flashes by which letters and words may be indicated. Flashes may also be given by moving the instrument if held in the hand. The above instrument answers well for all positions of the sun except when very low behind the observer's back. For this case another mirror is provided by which the light is reflected on to the mirror, A.

* Read before section A of the British Association, Swansea meeting.

THE DISTANCE OF CLOUDS.

ON DETERMINING THE HEIGHTS AND DISTANCES OF CLOUDS BY THEIR REFLECTIONS IN A LOW POOL OF WATER, AND IN A MERCURIAL HORIZON.*

By Francis Galton, M.A., F.R.S.

The calm surface of a sheet of water may be made to serve the purpose of a huge mirror in a gigantic vertical range finder, whereby a sufficiently large parallax may be obtained for the effective measurement of clouds. The observation of the heights and thicknesses of the different strata of clouds, and of their rates of movement, is at the present time perhaps the most promising, as it is the least explored branch of meteorology. As there are comparatively few places in England where the two conditions are found of a pool of water well screened from wind, and of a station situated many feet in height above it, the author hopes by the publication of this memoir to induce some qualified persons who have access to favorable stations, to interest themselves in the subject, and to make observations.

The necessary angles may be obtained with a sextant and mercurial horizon, but it is convenient, for reasons shortly to be explained, to have in addition a tripod stand, with a bar of wood across its top to support the mercurial trough, and some simple instrument for the rapid and rough measurement of altitudes. I have used the little pocket instrument sold by Casella, of Holborn Bars, London, called a "pocket alt-azimuth," and have employed Captain George's mercurial horizon on account of its steadiness and ease in manipulation. The observer has to determine:

1. The difference of level between the mercury and the pool of water (call it *d*).

2. The angle between the reflections of a part of a cloud in the mercury and in the pool (call it *p*). This should be carefully measured.

3. The angle between the portion of the cloud and its reflection in the mercury (call it 2 *a*). This may be roughly measured; its altitude, *a*, may most conveniently be taken at once by the pocket alt-azimuth or other instrument. The subjoined tables will then give the required result with great ease.

If *p* be not greater than 3 deg., and if *n* be the number of minutes of a degree in *p*, the error occasioned by writing $n \sin.^1$ for $\sin. n^1$, will never exceed 6 in. in 1,000 ft., and may be disregarded. Other errors of similar unimportance,

* Read before Section A of the British Association, Swansea meeting.

due to the eye not being close to the mercury, may also be ignored. Under these conditions, since log. sin. 1'=6·46373, it can be easily shown that

$$\text{distance of cloud} = \frac{d}{n} \times 6875{\cdot}5 \text{ cos. } (a+p),$$

$$\text{vertical height of cloud} = \text{distance} \times \text{sin. } a.$$

The following Table has been calculated for these values when $\frac{d}{n}=1$. To use it, multiply the tabular numbers by d (the difference in feet between the level of the mercury and that of the pool) and divide by n (the number of minutes of a degree in the angle between the reflection in the mercury and that in the pool). The result will be the distance, or height, as required in feet.

Table for calculating distances and heights of clouds by their reflections from a mercurial horizon, and from a pool of water at a lower level.

a=altitude of cloud (being half the sextant angle between the cloud and its reflection as seen in the *mercury*, not pool).

p=angle between the reflection of the cloud in the mercury and that in the pool.

d=vertical height of mercury above pool.

n=number of minutes of a degree in the angle, p.

Then the distances and heights of clouds=tabular numbers $\times \frac{d}{n}$.

$a+p$	Distance from Observer.	Vertical Height of Cloud above Observer.			
		n=0 (or p=0 deg.)	n=60 (or p=1 deg.)	n=120 (or p=2 deg.)	n=180 (or p=3 deg.)
deg.					
10	6771	1176	1059	942	825
15	6641	1719	1607	1494	1381
20	6461	2210	2103	1997	1889
25	6231	2633	2534	2435	2334
30	5954	2977	2886	2795	2703
35	5632	3230	3149	3067	2985
40	5267	3386	3314	3243	3170
45	4862	3438	3377	3316	3253
50	4419	3386	3335	3284	3232
55	3944	3230	3198	3150	3108
60	3438	2977	2947	2915	2883
65	2906	2633	2612	2597	2566
70	2352	2210	2195	2180	2165

The observation of the angle between the two reflections is perfectly easy with a full-sized sextant, if the trough of mercury be so propped up that the reflection from the pool can be viewed underneath the trough. For this purpose I used a tripod stand with a bar of rough wood, say 18 in. long, 3 in. wide, and 2 in. thick, secured horizontally across its top. I lay the mercurial horizon on one of its projecting ends, and between a few studs that have been driven in the bar to prevent its accidentally slipping off. The edge of the bar is beveled, and its thickness is reduced at the place where the mercury trough is set. Then the observation is taken, just as any other sextant observation would be. The reflection from the mercury falls upon the index-glass, and that from the pool is viewed directly through the object-glass below the trough and its supporting bar.

Unless the sextant be a full-sized one, this operation cannot be effected, because the index-glass will not stand high enough above the line of sight to catch the reflection from the mercury. It will simply reflect the side of the trough.

If there be no tripod stand, and it becomes necessary to lay the trough on the ground, an observation can still be made but in an inconvenient fashion. The sextant will have to be held topsy-turvy, that the brighter reflection of the cloud from the mercury, and not the feebler one from the pool, should be that which falls on its index-glass. The angle read will be negative; it will be what is commonly called an "off" angle. A small sextant may be used in this manner, because the rim of the trough is narrow that intervenes between the further edge of the mercury and the objects seen beyond and over it.

The most convenient method of measuring the rate of movement of clouds, after the height of the cloud plane has been once determined, is to watch the movements of a patch nearly overhead, and passing away from the zenith, as seen reflected in the mercury, and measuring its angle of depression (=its altitude) with some simple and suitable instrument, such as the pocket alt-azimuth already mentioned. Two measurements, a_1 and a_2, are taken, as well as the intervening time, t seconds, whence we obtain rate of movement = height of cloud × cotan. a_2 — cotan. a_1 in seconds.

When the water is almost wholly calm I find that two minutes of error is the utmost that need be feared. If quite calm one minute would be ample to make allowance for in a set of three or four observations. Now suppose we wish that our determination shall never be more than, say 10 per cent in error, we can easily find from the tables what the minimum height of the station must be in any given case to secure this result. In the first instance we should require a parallax of ten minutes and in the second of twenty minutes. This is obtained by an elevation of 10 ft. or 20 ft. as the case may be, when the height of the clouds in feet corresponds to the tabular numbers; that is, when it is between 2,000 ft. and 3,000 ft. At 100 ft. or 200 ft. elevation, clouds of ten times that height could be observed with equal accuracy. Numerous stations exist whence mountain tarns can be seen lying at a much lower level than this, and where even the highest cirrus could be measured with satisfactory precision.

Useful regular work might be done by a meteorologist whose station was at a height of even 50 ft. above a pool, supposing it to be so well sheltered from the wind as to frequently afford perfectly good reflections with, say, one minute maximum error. Very shallow water is much stiller than deep water, as waves cannot be propagated over it; thus we may often see wonderfully good reflections in roadside splashes and puddles, in the intervals between puffs of wind. The most stagnant air is in the middle of a high and broad plantation, where there is also plenty of dense underwood. Detached puddles of water in broad ruts would be the best equivalent for a pool. As regards the size of the pool, if we let fall a perpendicular k from the mercury trough to the level of the water, the utmost portion of the surface of the pool that can be used with effect extends between the distances of about ½k and 4k from the base of the perpendicular. The angles of depression would be then from 64 deg. to 14 deg. about, or say, a range of 50 deg. The usual limits would be from k to 3k, or between 45 deg. and 18 deg., being a range of 27 deg.

PHYSICS WITHOUT APPARATUS.

THE well known phenomenon of the duration of impressions on the retina may be shown by quite a number of simple and easily constructed apparatus. The simplest way of all is to whirl rapidly around in a circle a lighted stick, when the effect of a continuous ring of fire will be produced. The rapidity of revolution required to make this impression is one-third of a second in a dark room, and one-sixth of a second in daylight. The impression produced on the retina continues about the one-seventh part of a second, and on this principle the little optical toy called a *thaumatrope*, or wonder-turner, is constructed. It is shown in Figures 1 and 2, and is made as follows: On one side of a circular piece of

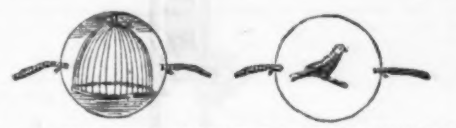


FIG. 1.—THE TWO SURFACES OF THE THAUMATROPE.

cardboard, having from one to three silken strings fixed to it, is drawn the figure of a bird; on the opposite side, a cage, so that when the card is twirled swiftly round by the two opposite strings the bird will seem to be inclosed within the cage (Fig. 2). The figures, of course, may be varied, as a horse on one side, and a rider on the other; or the figure of a Turk with two balls above him on one side, and two more on the other. In the last case, when the card is twirled around, the figure will appear tossing two, three, or four balls, according to the pair of strings employed.

Plateau's *phenakisticope* is more complicated; but still it can be readily constructed by any one having a little ingenuity. In this apparatus (Fig. 3), by looking through the narrow slits in the circumference of one of the cardboard disks we see apparently in active motion and assuming various positions, the figures that are drawn on the opposite and revolving disk. This apparatus has given rise to other well known optical toys based on the same principle, such as *zootropes, praxinoscopes, etc.* The persistency of luminous impressions on the retina may also be beautifully shown as follows: Cut out a circular disk of white cardboard and divide it into seven sectors having the proportions 56, 27, 27, 46, 48, 47, and 109 degrees. Now with a box of water colors paint these sectors, in the order named, the following colors: red, orange, yellow, green, blue, indigo, violet. Attach strings to the opposite margins of the disk, and then, as in the thaumatrope experiment, twirl the disk very rapidly. The seven simple colors will apparently disappear, and the disk will appear white. Among experiments relating to the subject of optics there are several which may be performed with concave or convex mirrors, which have the property of very curiously distorting images. Such mirrors may be very well extemporized by means of quite a number of objects that are nearly always at hand. For instance, a highly-polished silver or plated coffee-pot serves as a very good substitute for a convex mirror, although a much better one is found in the silvered globes which are frequently used as ornaments. These present to the observer at one view an image of nearly all surrounding objects, very notably distorted, however, since straight lines are reflected as curves. Much greater deformations are produced by cylindrical mirrors. One of these, when the axis of the cylinder is vertical, behaves like a plane mirror as regards the angular magnitude under which the height of the image is seen, and like a spherical mirror as regards the breadth of the image. Distorted pictures are sometimes drawn upon paper, according to such a system that, when they are seen reflected in a cylindrical mirror properly placed, the distortion is corrected; and, while the picture appears a mass of confusion, the image is easily recognized. This restoration of true proportion in a picture is called *anamorphosis*. Any one can easily make such drawings; and as for the cylindrical mirror, that may be readily extemporized by a glass tube filled with mercury. By the use of conical mirrors very peculiar effects may be obtained, which are not less interesting than those just mentioned.

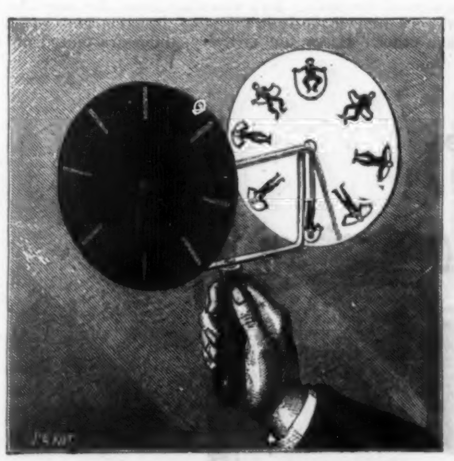


FIG. 3.—PLATEAU'S PHENAKISTICOPE.

Many ingenious illusions have been contrived, depending on the laws of reflection from plane surfaces. Among these, is the striking one known as "Pepper's Ghost," which was contrived for theaters by the physicist Robin, and which formerly attracted great attention. This spectral illusion is produced by reflection from a large sheet of unsilvered plate-glass (like those used in shop windows), which is so arranged that the actors on the stage are seen through it, while other actors placed in strong illumination, and out of direct view of the spectators, are seen by reflection in it, and appear as ghosts on the stage. These same effects are very often seen produced on the window panes of our dwellings at night. In recent years this same principle of optics has been very ingeniously utilized in the construction of an apparatus designed to facilitate the acquisition of the art of drawing. A pane of glass is fixed vertically on a black base. The drawing to be copied is placed to the left of the glass, and the drawing paper to the right. Now if the draughtsman places himself in such a way that the visual ray passes obliquely through the pane, he will see the image of the drawing very clearly projected on the paper to his right,

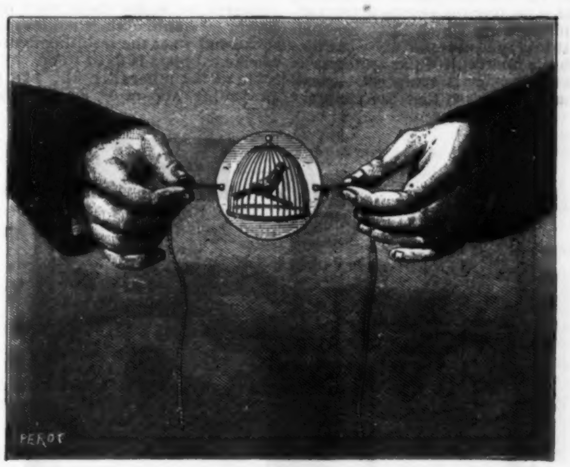


FIG. 2.—THE THAUMATROPE BEING ROTATED.

and it will only be necessary to follow its outlines with a pencil in order to obtain a correct copy.

This, then, is a very easy way of showing the principle involved in the phenomenon of "Pepper's Ghost." One of the most striking applications of mirrors for the amusement of an audience is undoubtedly that seen in the contrivance known as the *magic cabinet*. Some years ago an exhibition of this kind drew large audiences of curiosity-seekers to witness it, both at Paris and in a large number of other cities. The visitors, on casting their eyes in a small cabinet into which no one was allowed to enter, saw a small three-legged table on which lay a large plate containing a human head. This head, which was seemingly that of a decapitated person, moved its eyes, made grimaces, and talked. Although the spectators believed that they saw an empty space beneath the table, the individual to whom the head belonged was really seated there, his body being hidden by two vertical glass mirrors fitted between the legs of the table at an angle of 45° with the two side walls. The whole was so arranged that these two walls coincided with the visible portions of the wall in the rear of the cabinet. The three walls were painted of a homogeneous color; and the illusion being enhanced by the feeble light employed, the effect was very remarkable. Had some spectator, however, thrown a stone between the table-legs a crash of glass would have at once unveiled the mystery. One of the simplest objects for illustrating the subject of reflection from plane surfaces is a toy well known to every child—the *kaleidoscope*, which from the beautifully symmetrical distributions of images formed within it, has become an important aid to designers. This pleasing apparatus is sold very cheap, but may be easily constructed at slight expense by any one having the least ingenuity.

ACOUSTICS IN PROJECTION.

ACOUSTICAL experiments may in general be exhibited by mechanical experiments, so that, aural observation being replaced by ocular, the phenomena become clearer to the mind through the aid of the second sense. Besides, by such a method they become capable of being accurately measured. This double problem, in so far as it relates to experiments with tuning forks, has been resolved by M. Albert Duboscq in the most perfect, elegant, and practical way. He has succeeded in reproducing all such experiments with a single instrument, which allows of all possible positions being given to tuning forks, and, by uniting with it his horizontal projecting apparatus, he is enabled to exhibit to a large audience the minutest phenomena in their least details. The tuning fork is arranged to slide in a horizontal slot mounted on an arm which slides on a vertical column (Fig. 5.) This slot may be fixed at any height whatever, and may be revolved at pleasure around a vertical as well as a horizontal axis. In fine, the tuning fork may be placed at any angle whatever, and thus vibrate in either a horizontal,

vertical, or inclined plane. The vibrations are produced, not by a bow, but by means of electricity, thus rendering them as unvarying and as lasting as possible. This is effected by the process which was pointed out by M. Mercadier. The slot carries an electro-magnet fixed between the arms of the tuning fork, and, externally, at the side, an interrupter—that is, a small metallic button which may at pleasure be made to approach or recede from a style affixed

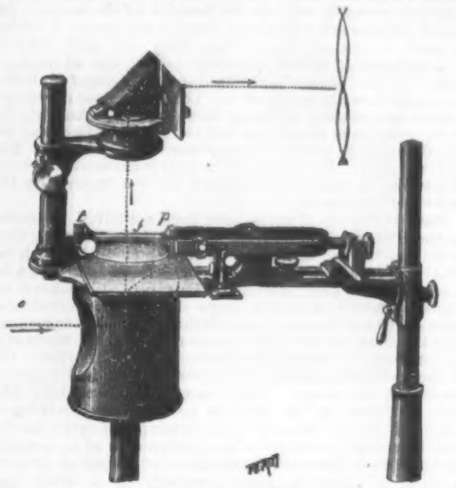


FIG. 1.—VIBRATION OF STRING ATTACHED TO TUNING FORK.

to one of the arms. One of the wires of the battery is attached to the electro-magnet and the other to the interrupter, and according as there is, or is not, a contact between the interrupter and the style, the current passes or is interrupted. When the current is passing the electro-magnet attracts the arms of the tuning fork, which then approach each other, but through this very cause the style recedes from the button, the current is intercepted, the arms recede from each other, and then the contact is again established, the arms again approach, and so on, so that the vibratory

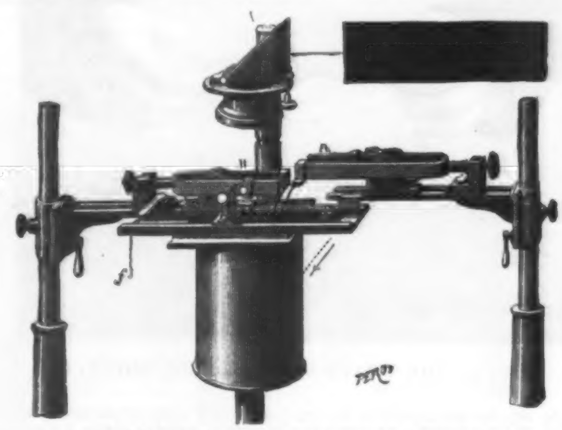


FIG. 2.—RELATIONS OF HARMONIOUS VIBRATIONS.

motion keeps up automatically. Two similar supports, to which are added, as need may be, the various parts necessary, allow the following experiments to be performed. One of the simplest consists in showing the vibrations of a string attached to a tuning fork. It is an experiment of Melde's (Fig. 1). A thread is tied to the end of one of the arms of the tuning fork, and its opposite extremity is wound round a small roller fixed to a shelf on the projecting apparatus. The thread passes exactly over the illuminating lens, and its image is formed on the screen. As soon as the tuning fork is caused to vibrate the thread itself enters into vibration and exhibits the appearance shown in Fig. 1.

FIG. 3.—TUNING FORKS ARRANGED TO REACT ON EACH OTHER.

Every one knows that the sound made by a tuning fork depends on the number of vibrations that it makes per second. When two bodies vibrate together and the resulting accord is harmonious, the number of vibrations bear in general a simple relation to each other. To show this, two tuning forks, giving for example the one *ut* and the other *sol* (that is, forming an interval of a fifth), are placed on the supports that we have just described. It is very easy to compare them. Each is provided with an inscribing style (Fig. 2), and the whole arrangement is attached to the projecting apparatus. Over the illuminating lens of the latter is placed a slip of glass coated with lamp black, on which have been drawn small equidistant parallel lines. The glass is made to slide in a grooved frame, and the styles are arranged so that they just graze its surface. When the tuning forks are set in vibration electrically, and the glass slide is rapidly drawn along by hand, there will be seen projected on the screen two sets of curves (as shown in the figure), which are counterparts of those that are being traced by the

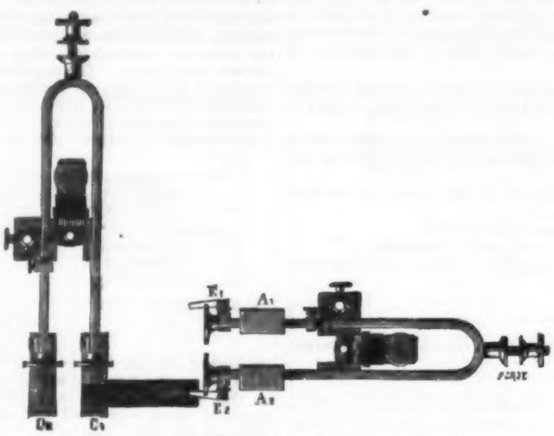


FIG. 4.—INSCRIPTION OF THE LISSAJOUS FIGURES.

style on the blackened glass. On afterwards counting the number of undulations that occur between any two of the lines ruled on the glass, we find that they are in this case in the very simple ratio 3 to 2. In this experiment two tuning forks are made to vibrate at the same time, but without any endeavor to make them react on each other. We may, however, combine their motions, and find what sound they make and what the resulting figure will be. To do this, the blackened glass is fixed to one of the tuning forks and the style to the other (Fig. 3). The glass is placed above the projecting apparatus, and as near as possible to the illuminating lens, so as to have a very wide field; and the style attached to the other tuning fork is caused to bear very lightly on the slide. Things being arranged thus, the two tuning forks are made to vibrate electrically, and the one carrying the style is drawn backward. Then will appear on the screen the curves which are being inscribed on the glass. If the two tuning forks are in perfect unison the curve which results will be a sinuous line the amplitude of which is double what it would be if the line represented the motion of one tuning fork vibrating alone, for here the vibrations are constantly in the same direction and added to each other. If, on the contrary, slides are placed on the arms of the tuning forks so that the latter will not be in accord, but will have a slight difference in the number of their vibrations, the sound is re-enforced and weakened by turns, producing what are called "beatings." At the same time the amplitude of the waves of the sinuous lines shows variations which agree with the beatings, and the appearance of the sound waves as shown on the screen will be like those represented in Fig. 3. M. Duboscq has even succeeded in inscribing and projecting, just as simply, the Lissajous figures, and this is the most original part of his labors, for this result had not hitherto been obtained. It will be remembered that M. Lissajous causes two tuning forks to vibrate—one in a horizontal and the other in a vertical plane. Both are provided with mirrors centered at the ends of their arms. The mirror of one of them receives the rays emanating from a luminous point and reflects it on the mirror of the other, and which in turn reflects it upon a screen. The two tuning forks vibrate in rectangular planes, and the combination of these two motions leads the second image of the luminous point to describe on the screen a very beautiful curve, which has a special form for each interval—unison, octave, fifth, fourth, etc. Moreover, each curve varies slowly and continuously, because the beginnings of the vibrations do not coincide, there being always a slight difference in their phases. In order to inscribe these figures in projection and preserve a drawing of them, M. Duboscq affixes to one of the tuning forks an inscribing style, and to the other a

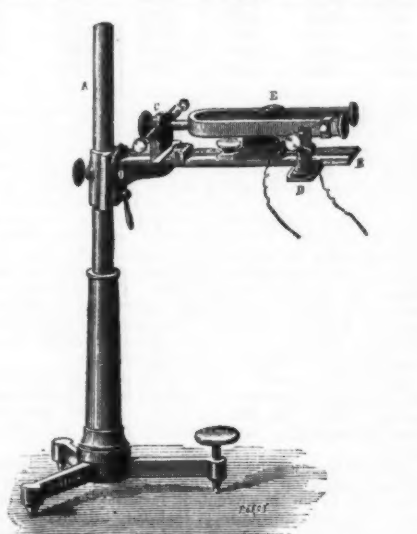


FIG. 5.—TUNING FORK MOUNTED IN A SLOT.

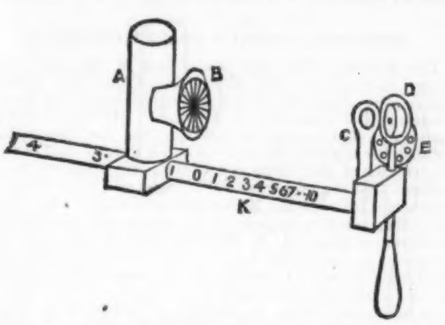
blackened glass. Then he repeats M. Lissajous's experiment optically in order to regulate it perfectly. The two tuning forks are placed opposite each other, one vertically and the other horizontally, and care is taken to load them with weights suitable for producing any figure that may be desired. (Fig 4.) This done, and the apparatus being perfectly regulated, the two tuning forks are arranged so that their axes are perpendicular to each other. Their vibrations then take place horizontally, but always in two rectangular directions, as required in M. Lissajous's experiment. The blackened glass must be as near as possible to the condenser, and at a slight distance from the inscribing style, which is a little above it. When these two tuning forks are in vibration, the one carrying the style is lowered by means of the leveling screw of the support in such a way that the style rests gently on the blackened glass, and the figure will then be seen to trace itself. As soon as it is formed care must be taken to raise the tuning fork by turning the leveling screw in the opposite direction, otherwise only a confused drawing would be obtained. This process, then, may be considered very justly as the complement of M. Lissajous's optical method, for here it is the tuning forks themselves—in other words, the sound producer—which trace the curves formed by the composition of the two vibrating motions. The tracing is then only a translation, by an extremely simple process, of the impression that the ear has received, and nothing is more easy than to read the interval between two notes that have just been heard.

NEW INSTRUMENT FOR ESTIMATING ASTIGMATISM.

By TEMPEST ANDERSON, M.D., B.Sc., Fellow of University College, London.

ASTIGMATISM is that condition of the eye in which the refraction is different in different meridians of the eye, owing to the refractive media not being perfectly symmetrical. An eye with a cornea shaped like the bowl of a spoon, instead of like a portion of a sphere, would be astigmatic. The instrument exhibited by the author at the meeting of the British Association at Swansea has the following advantages. 1. The observations and measurements are made by the observer, and are entirely independent of the patient's sensations. 2. An image thrown on the retina being used as an object, the error arising from the vessels or optic nerve being before or behind the retina is avoided. 3. The refrac-

tion and accommodation of the observer does not affect the result. It is only necessary that he should be able to see whether certain lines are sharply defined. A lamp, A, in the engraving) is provided with a condensing lens, which has a screen of radiating wires, B, across its front, thus giving a bright field with black lines. This slides on a graduated bar, K, at the other end of which is a convex lens, C. It is better to have two of these of different powers, 4 and 10 dioptrics being convenient. Close to the lens, and at an angle of 45° to it, is a plane silvered mirror, D, which reflects the rays at right angles to their former path. The instrument is held so that this pencil of rays enter the observed eye, and when the screen is at the proper distance an image of it is formed on the retina. The mirror has its center left unsilvered, and has an ordinary disk of lenses, E, behind it, to render the retina and the image on it visible to the observer by the ordinary direct method. The bar is so graduated that when an image of the whole or part of the screen is sharp on the retina, the figure opposite the screen expresses the refractive error of the meridian by which the image is



A, Lamp. B, Condensing lens and wires. E, Graduated bar. C, Convex lens. D, Mirror. E, Disk of lenses.

produced. Hence, if the image of the whole screen is seen to be equally sharp, the eye is known to be not astigmatic, and the graduation gives the number of dioptrics by which it is myopic or hypermetropic. If the lines be not all sharp at once, then the most distant point at which any of them is distinct gives the refraction of the meridian of minimum refraction, and the point at which that at right angles to the former is distinct gives that of maximum refraction. The least of these gives the spherical element of the correcting spectacle required, and their difference that of the cylindrical element. The meridian of maximum refraction is that in which the line appears distinct when the screen is at the greatest distance. If the cylindrical lens be convex its axis must be in this meridian; if concave, then at right angles to it. The makers are Cook & Sons, York.—*Lancet.*

THE SEA CAT.

"SEA CAT" is the popular name bestowed on certain cartilaginous fishes of the order *Holocephala* because of a peculiarity of their eyes, which have a greenish pupil, surrounded by a white iris, and which have the property of shining, especially at night, like the eyes of the cat. These fishes seem to form a group intermediate between sturgeons and sharks. Nothing is stranger and more ugly in appearance than one of these fishes, especially the species represented in the engraving, and which is well deserving of its scientific name, *Chimæra monstrosa*. It is from three to four feet long, and its body, from the base of its enormous head, gradually diminishes in size and ends in a long slender tail like that of some reptile. Its skin is smooth, elastic, and flabby, of a silvery white, and covered with scales that are so minute that they are scarcely perceptible to the touch. It is thrown into folds and sinuous wrinkles all along the body and on the top of the head, so that it appears to be too large for the body that it envelops. Under the mouth, and on the lateral faces of the snout, it is perforated with numerous holes, from which issues a glutinous mucus. The pectoral fins are supported on a sort of thick fleshy arm. Before and behind the ventrals hang two appendages resembling small paws. Between the eyes there is a large fleshy club-shaped process, with serrated edge, and ending in a spine, which somewhat resembles a crown, and has given rise to one of the popular names of the fish—"king of the herrings." What makes the sea cat still more hideous is its quick and odd movements, bending and twisting, as it does, in all possible directions. Besides this, the different parts of its snout are constantly in motion, so that it has the appearance of making grimaces, which have been compared to those made by monkeys. There are two kinds of this fish—the northern sea cat (represented in the engraving), which is found in the North Sea and Northern Atlantic, and the southern sea cat (*Callorhyncus australis*), inhabiting the southern seas. The first of these pursues shoals of herrings and other migratory fish, and also feeds on jelly fishes and crustaceans. Its flesh is tough, but the Norwegians use the eggs (which, as in the sharks, are inclosed in a leathery capsule) as food, and employ the oil of the liver in diseases of the eyes and for wounds. In the southern sea cat the snout ends in a gristly appendage, bent backward at the end so as to resemble a hoe; the anterior dorsal is very far forward over the pectorals; the second over the ventrals and reaching to the caudal, and the tail does not end in a filament. The singular shape of its snout, which is not unlike that of the tapir, has gained for it the familiar name of "elephant fish." It is about the same size as the northern animal, and is silvery, tinged with yellowish brown.

NEW FISHES.

THE Academy of Science held its regular meeting, July 19, C. W. Brooks presiding. W. N. Lockington introduced several new species of fish which he had found at several points along the coast. Since last January forty new species have been discovered, most of them supposed by scientists to be confined to the Asiatic coast of the Pacific, or to the Atlantic. Mr. Lockington explains that the reason for finding so many new species along the coast was because fishermen have been seeking new deep water fishing and have therefore found so many fish which have hitherto been strangers to our market. The speaker referred to the whiting in particular, which was until recently a rarity, but latterly it is seen in abundance at the fish market, and is of a larger species than that formerly sold. A fine specimen of a tope was shown, which, the speaker explained, was found by Prof. Jordan along the coast of San Luis Obispo. It has hitherto been believed to be entirely confined to European waters, but it abounds along that portion of the coast where the specimen was found, and is a source of revenue to the Chinese fishermen of San Luis, who catch these sharks from six to twelve feet long, and extract the oil, amounting to twelve pounds in a large fish, while the fins are preserved and sent to China. The speaker mentioned another curiosity of the finny tribe, commonly known in Europe as the king of the herrings. Prof. Jordan has ascertained that this voracious sea monster, which is seldom seen out of the deep waters of the ocean, exists in our waters. It eats quantities of herrings, living almost entirely upon them, hence its name. The speaker concluded by saying that Monterey Bay was the richest collection point on this coast, as it seems to be the dividing point between the southern and the northern waters. Here all the species of the northern seas and almost all of the south are. A king crab was exhibited, this being the first ever found on the coast. It is supposed that the young were brought from the East with some of the oysters which were shipped from there. The king crab is the most ancient of the crustacea.—*San Francisco Chronicle.*

A FISH THAT SWALLOWS BIGGER ONES.

THE Smithsonian Institution has received a very curious specimen of the fish kind, recently found on the fishing banks of Gloucester, Mass., by Mr. A. Howard Clarke. It rejoices in the name of *Chiasmodus niger*, and its peculiar and distinguishing feature is the fact that its rapacity leads it to swallow fishes which are twice as large and weigh four times as much as itself. It is enabled to do this from the fact that its mouth is very deeply cleft, its teeth bent, and that its stomach has an elasticity resembling India-rubber. When it commences to swallow its dinner its jaws move alternately, and seem to climb over the fish, which is gulped down and doubled up in this curious creature's inside. As the process of digestion and decomposition takes place, and gases are originated, the distended stomach becomes lighter than the other part of the body, and the latter consequently turns under. In this condition the fish is utterly unable to help itself, and may be easily caught. This specimen, secured by the Smithsonian, is only the third known. The first was found a number of years ago floating in the sea off the Island of Madeira, and the second was discovered in the Dominican Sea. Careful drawings have been made of this particular specimen, which is 10 inches in length. It has in its stomach a kind of codfish, 18 inches long. It is only by contrasting the long and slender body of the fish in its normal state with its distended form after gorging, that a proper idea of the feat it so successfully attempts can be gained.—*Washington Post.*

THE SEA CAT.

CONTEST BETWEEN A LIZARD AND SCORPION.

GEORGE JENNINGS, the well-known tailings sluice man of Six-mile Cañon, describes a queer battle which he witnessed one day last week between a lizard and a scorpion. He says the lizard, a black one about eight inches in length, came out of a pile of lumber, and his attention was first particularly attracted to it by seeing it bobbing its head up and down in an excited manner, occasionally creeping forward a foot or two. Looking in the direction in which the lizard was creeping, Mr. Jennings observed a scorpion, some four inches in length, sitting upon a pile of moist sand that had accumulated near one of the sluice boxes. Thinking the lizard meant to attack the scorpion, and being curious to see what would be the result of a battle between the pair, Mr. Jennings was careful to do nothing that would disturb either. The lizard moved quite near the scorpion, when it braced itself upon its forefeet and began bobbing its head and bowing in a ludicrous way. The scorpion erected its tail, which it vibrated in a threatening manner. The lizard circled round the scorpion, occasionally halting to bow at him. At length, however, the scorpion attempted to crawl away. The moment he began crawling the lizard darted upon him like a flash, and adroitly seized him by the last joint of the tail—that which contains the poison sac and at the point of which is situated the sting. Having this hold of the scorpion, the lizard was safe from its sting, but had apparently no means of doing any further damage. Presently the scorpion twisted himself about and tried to get hold of the lizard with his claws, which are like the claws of a lobster or crawfish, whereupon the lizard shook him as a dog would shake a rat. This was repeated dozens of times, the lizard resting after each shaking until the scorpion began to go for him with his nippers. The battle lasted over half an hour. At last the scorpion no longer showed fight, and the lizard dragged him away into the lumber pile. Mr. Jennings says he has been in the country twenty years, has seen lizards daily by scores during the summer months, and scorpions very frequently, but never before saw a battle of the kind, and never had the least idea that a lizard would attack a scorpion.—*Virginia City Enterprise.*

INDIVIDUAL LIFE FROM AN EVOLUTIONARY POINT OF VIEW.

By G. GLASER.

ONE of the objections raised against the theory of evolution by sentimental people has always been that the advocates of this theory place too little importance upon individual life and deny individual immortality altogether. It will, therefore, be timely to ascertain whether individual life is really of so great a value, and to glance at its real and natural meaning from a scientific standpoint.

A human individual is usually considered as a being whose earthly existence is distinctly limited by space and time, but according to the theory of evolution, men as well as all other beings form only a part of a great whole; the limitation by space and time is not at all distinct, and seems to be of little importance, because it is only accidental. Scientific investigations have proved that the whole animal world, man included, is derived from small primitive organisms, such as may be found even at the present time. These primitive organisms are nothing else but little lumps, which continually change in form and appearance, and which consist of a slimy matter, the so-called *protoplasm*—a liquid which also forms the principal substance of higher organized bodies, and from which all other constituents of the body are developed by chemical transformation. They may be found in most ponds, and their life consists in breathing—a process of slow oxidization, by which the volume of the body is diminished; in eating—by which the original volume is increased, and in motion—a natural consequence of many processes of oxidation. None of these three processes of life necessitates the limitation of their body by space or time. The primitive animal could live an eternity if the diminishing of its body by breathing would be balanced by the increase of its body by eating. It would also grow forever, if the continued increase should outweigh the diminution, and, space and time permitting, its life would indeed be eternal if the body, on reaching a certain volume, did not divide itself into two parts.

This division of a protoplasm, having a certain composition and containing a certain quantity of oxygen, seems always to take place when its body has reached a certain size by a continued increase of the nourishment. And at this point we have to speak of a certain limitation by space, but not yet of a limitation by time. If the parts formed by this division are of unequal size, we might call the smaller one a new being, for we certainly would not so call the larger one. If this part grows again and is divided anew, we will be tempted to say that it continues its existence in the larger part. If in this case, when the parts are unequal, we cannot say that the individual died, then neither will we have any right to speak of the death of this being, when the division which takes place is that of equal parts. What then, let us ask, is it that is generally considered to be individual death?

This term is usually applied when the protoplasm during its growth by the single development of its constituents has reached a more complicated form, similar to that of a machine, in which all parts fit harmoniously into one another; and finally, this complicated body, by the wearing out or disarrangement of some of these parts, undergoes a decomposition which entirely changes its form and renders it unfit to perform certain functions.

But let us now see how far this individual death is really the extinction of individual life, and for this purpose we will return to our protoplasm. We have seen that the propagation of the protoplasm is carried on by the division of its body into two parts. Let us now suppose that that part which we name the new being is one-half as large as that part which constitutes the mother, then this latter after its first division (propagation) still retains two-thirds of its original substance, after its second division only $\frac{2}{3}$ of $\frac{2}{3}$, or $\frac{4}{9}$ of its original body are contained in it, and after the third division only $\frac{8}{27}$ remain. If the mother piece should

now really die or enter into decomposition, then not even a third part of the original being is annihilated; yes, even more, if that part which was first separated by the division—let us call it the first child—has, meanwhile, not been again divided, then it still contains a whole third of the original being, and it therefore represents the original being more completely than the $\frac{8}{27}$ of the dying mother.

Not all animals, it is true, are divided in the proportion of 2 to 1, but although the quotient for the higher developed animals is much greater, the enormous number of propagations, in some of them, makes up for this difference; so, although the egg of the sturgeon which we eat in the caviar measures only a minimum part of an inch, this animal nevertheless furnishes every year one-fourth of its weight in caviar; and though this animal might not attain to any great age, within a few years its progeny would represent a far greater part of the original sturgeon than the mother at the hour of its death. Although, as regards the quantity of original matter contained in the progeny, the same will not hold good with many other animals, and among them man. We have no right to say that only the sturgeon is immortal, and our anti-Darwinistic readers will be rejoiced to hear that even evolutionists grant immortality to man, for it is not the quantity of the original substance that determines the continuation of individuality, but rather the quality of that substance, and that the living substance in the egg is perfectly identified with that of the mother, not only as regards fishes, but also as regards the vertebrates, and man can be doubted by no one who observes with an open eye, how even the smallest details are transmitted by inheritance.

As yet we have spoken only of an individual continuation of the body, but scientific facts teach that the individuality of the mind also continues. Talents and properties of character are transmitted from one generation to another, and that which we call *instinct* is nothing else than an obscure remembrance of experiences which were made by earlier generations. A *clear* remembrance which extends over the boundaries of our individual life has, it is true, not yet been found among men, but this does not prove anything against the above assertion. Such a remembrance we do not possess even for the complete period of our present life. Our memory does not extend back to the first years of our infancy. It is interrupted by sleep; it may be strengthened by exercise or weakened by neglect, it may be interrupted by many abnormal states by which life itself is not interrupted. Whether in dreams, or in conditions of abnormal nervous excitement, in hysterics or other sickness, memory is increased, so that it really extends over the period of our so-called individual life, is a question which, although much abused by humbugs and impostors, might still arrest the attention of the scientific investigator. And though it remains an open question whether the memory of man has such an extension, and though even for the human race the contrary may be proven, it nevertheless might be possible that some animals are endowed with a memory which reaches far beyond their so-called individual existence.

What we have said above seems to prove that life, in relation to time, continues to exist for unlimited periods, and, therefore, one of the qualities which are said to constitute individuality, viz., the limitation by time, does, strictly speaking, not exist. We come to the second quality, viz., the limitation of space.

After the division of the first protoplasm into two parts, may those be of equal or of unequal size, there exist two beings, but neither of them is a new being, they are only parts of a whole of still existing life. These two parts may not necessarily be completely separated, they may have a common point of connection. By such a process, from polyps which have the shape of a calyx, by a continued, incomplete division, compound organisms are formed which have the shape of a cluster of blossoms, and, although the different parts are not perfectly separated, they can nevertheless be called single beings. The connection may be even closer. There exist some corals, in which the single calyxes are only indicated by a slight furrow, and others in which even this furrow is wanting, and is replaced by a ring of feelers which surrounds each mouth-opening, and still others, where even the feelers fail, and mouth-openings alone indicate the point of contact. Such is the case in the species Meandrina. The cluster represents a globular lump, which is formed by a meandering band, both margins of which are indicated by a series of feelers; while in its middle line, at equal distances, several mouth-openings may be seen. Nevertheless, this cluster consists of a great number of separate beings. We might here say so many mouths, so many individuals, but we certainly cannot speak of a limitation by space. And if we would speak of the individual, in the sense in which it is commonly applied, as a being, one of the chief characteristics of which is its limitation by space, then we would have to call the whole coral cluster an individual.

This predicate is still more deserved by some polyp colonies, which consist of single polyps, of which the one in the course of time has lost its mouth and its stomach, but has highly-developed feelers, which are well adapted for securing prey; while the other has lost its feelers, but has an enormous stomach and a great mouth; while a third, having lost mouth, stomach, and feelers, possesses practical organs for motion. While the one rows the whole colony around in the water, another provides nourishment by its feelers, and a third eats and digests it, sending through a proper system of channels to each of the brothers a part of the digested nourishment which serves to maintain their life. Is this now a system of individuals, or one individual with different organs? Against the latter view nothing speaks but the fact that these organs look like single polyps, and in some species, where the division of labor is not quite so complete, are finally separated entirely, and continue their life as beings limited by space.

We see, therefore, that limitation by space is not an essential characteristic for the individual, but closer investigation will teach us that there may exist single beings which are distinctly limited by space, and yet which could not be properly called individuals. We speak of the so-called polymorphism, the simplest form of which is the sexual dimorphism, and which is characteristic of all higher animals. Single beings of these animals are not able to propagate themselves alone, and two beings, whose sexual organs are differently constructed, are always necessary for the production of offspring. Trimorphism—*i.e.*, a condition of life where beings of three different kinds are necessary to perform the complete functions which properly belong to one individual, is represented by the bees, which have the further peculiarity that the one form—viz., that of the queen bee—is only once represented, while the drones and the working bees exist in great numbers. In this latter case the hive represents a closer unity of life, in which all members are descendants, in the first degree, of one mother. The societies of ants display an organization very similar to that of the bees, with the exception that here four, and sometimes five, different kinds of beings are necessary to the performance of the common functions of life, and that, for the reason that in these societies many females are present, the single members, although being still closely related, are no longer brothers and sisters. The highest evolution of this polymorphism we see in the human society, in which the division of labor has reached an enormous complexity, and in which the single members are just as, or even more, dependent upon each other as those of the societies of lower animals.

From this point of view the life of a single being appears only as a part of collective life, and the limitation of the single beings by space is not essential, but only accidental. Let us now consider the real and practical *value* of the life of single beings. Polymorphism, or the division of labor, is of the highest importance for animal development. Individuals that exist as a unity, as the hypothetical "Bathybius Haeckelii," will not change or improve their qualities very much so long as the external conditions in which they live remain the same, and the insignificant variations which the lower animals have experienced in the course of centuries are a proof of this fact. If local conditions influence the one part of their body favorably, while they have an injurious influence upon another part, the equilibrium is restored in the bodies themselves. Very different is the case when a collective life is represented by several organisms which are distinctly separated locally. In this case external conditions injure some beings while they benefit others, and by their action these beings are changed and become dissimilar. Even more. As soon as this dissimilitude is established equal external conditions have a different influence upon the different beings, and these latter are no longer endowed with an equal power of resistance. The unfit ones will be destroyed, while the more fit will survive. Thus the division of a collective life into single lives is a necessary condition to its further improvement. Although a distinct local separation is not absolutely necessary for a higher development, and although it is more essential that the different parts have a great variety of forms, nevertheless this local separation is a great aid to this development. The most perfect polymorphism will be that in which the difference of the functions of the single members and their local separation are well balanced. But we must not imagine that the highest possible degree of the division of labor, together with the highest possible local separation, would be most practical. We have only to remind our readers of the old anecdote of the blind man and the lame man. If these two persons, in whom the division of labor is so complete, were locally separated they would of necessity perish, while, when the blind man takes the lame man upon his shoulders, they will be a mutual help to each other in the struggle for existence. Therefore, if the division of labor is too great, the single beings lose their independence, and a great expansion in space is prevented. The division of a collective life into single lives, and a local separation of the single beings, will only then be beneficial, when by this local separation all the single beings which are unfit to fulfill their functions can be destroyed without injury to the whole, while a survival of the fit beings, and, therefore, an improvement of the whole, which thus will always be preserved in a healthy state, will be granted.

This contemplation affords us a correct idea regarding the value of single life. Single life, or, as it is so often incorrectly called, individual life, must only be considered as a part of collective life, and the value of the single being only depends upon the value which this being bears to the whole to which it belongs. Man is to be looked at as a part of humanity, and his individual life must be measured according to the value which it has for human society.

The practical inference which may be drawn from this cognition is that the best state will be so organized that the most fit and most useful of its members are highly protected, while the life of the unfit ones is made impossible; and from a scientific point of view it is evident that individual life has been greatly overvalued, while the benefit of society has been too little considered.

The evolution theory teaches us the wholesome lesson, that a due consideration for the life of society is at the same time a protection of its most excellent members, and that a due consideration for its most excellent members is at the same time a protection for society.

VESTIGES OF THE ANCIENT HITTITES.

THE most remarkable of all Hittite monuments are the sculptures at Eyuk, near Bogahz Keui, first discovered by Hamilton, and since photographed by Perrot. Here on the slope of a low hill are the remains of a palace, built not of limestone, like the other monuments of Asia Minor, but of dark granite. Ruined as it is, sufficient is left to show that it was modeled on the plan of the palaces of Assyria. At its entrance are two huge monoliths, with the faces carved into the likeness of sphinxes. But the sphinxes, though inspired by the art of Egypt, are profoundly different from the sphinxes of the valley of the Nile, and only their feet and faces are hewn out of the stone. One of the monoliths further bears upon it the same double eagle that is portrayed on the rocks of Pteria; but this double eagle once supported the figure of a god. The monoliths were flanked by walls, one of which is still fairly preserved. Along it runs a line of sculptures which carry, each one of them, the impress of Hittite art. Here we may see the Hittite warrior in his peculiar dress; there the Hittite priest robed as he is at Boghaz Keui. Elsewhere the building of the palace itself is brought before our eyes, and the workmen are represented ascending a ladder, or otherwise assisting in the work. Elsewhere, again, is a bull mounted on a sort of pedestal, and drawn with the skill that characterizes the delineation of the animal forms occurring among the Hittite characters; or, again, it is a musician and a snake charmer. Hard by is a man leading a monkey—a picture we might think somewhat out of place in so cold and northern a country. But, curiously enough, it is with monkeys that the Assyrian monuments associate the kinsmen of the Hittites, who inhabited those very regions. On the walls of the palace of Assur-natsir-pal at Nimrud or Calah, an attendant in peaked boots is leading a monkey, just as he is at Eyuk, and following his lord, who wears the characteristic cap and shoes of the Hittite race. The black obelisk of Shalmaneser, the son of Assur-natsir-pal, tells us that he too received apes and monkeys from the people of Muzri, in Western Armenia, and among the tribute-bearers are some represented in the familiar Phrygian cap and tip-tilted shoes. It is thus that we now know how, at an age of which history and tradition are alike silent, the influence and art and writing of the Hittites were making their way to the far West, carrying with them the elements of Eastern civilization. The twofold road they traveled over became one at Sardes, which was thus predestined to be the future center of power and civilizing influence throughout the Western world. The interest that envelops the rock-carving of Karabel is accordingly very great; the fact that the onward Hittite civilization was stayed only by the waters of the Ægean is there engraved, as it were, in stone. But this is not the only interest that attaches to the sculptures. Long before the days of Renouard or of Texier the Ionic settlers in Lydia had gazed upon the sculpture and wondered whose it was. "The father of history," Herodotus, himself guessed, though vainly, at its origin. He tells us that "in Ionia are two figures carved on the rocks, one by the road that leads from the Ephesian territory to Phokæa, the other by that which leads from Sardes to Smyrna; in each case a man is sculptured three feet in height, the right hand armed with a spear, and the left with a bow, and the rest of his clothing to match, for it is Egyptian and Ethiopic, and the sacred characters of Egypt run carved across the breast from shoulder to shoulder, with this meaning, 'I won this land with my shoulders.'"—*Frazer's Magazine.*

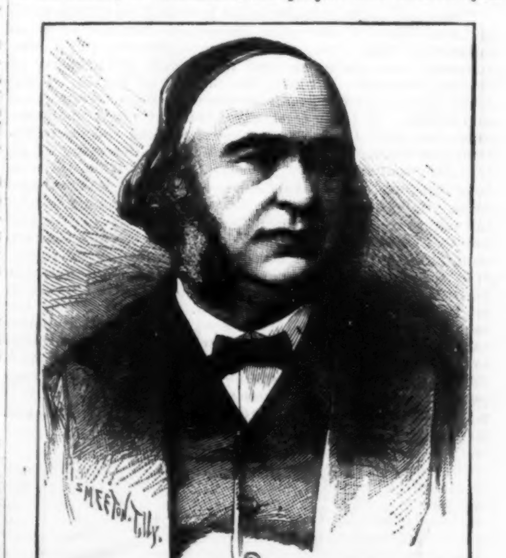
FORMING A GENUS IN ANTICIPATION.

THE *American Naturalist* states that M. Mortillet has recently discussed in the *Revue Scientifique*, the probable maker of the flints found in the Miocene deposits of Thenay, Cantal, and of a locality in Portugal. He rejects the proposition of Gaudry that the artificer was the *Dryopithecus*, because the horizon of the flints is not exactly that in which the remains of that large ape occur. He proposes the hypothesis that the problematical being was a form which has intervened between the higher apes and man. Thus far M Mortillet's position appears to be reasonable, provided that his flints are artificial. M. Mortillet goes further. He names the genus to which this being is to be referred, and calls it *Anthropopithecus*. As he has not the shadow of a definition for the genus, its proposition is in violation of all rules. He then proceeds to name the species, of which he enumerates three. His method of distinguishing these is not zoological; they are proposed on inference as to their differential characters, which extends to size only. The dimensions are estimated by those of the flints, one species having manufactured large implements and another small ones. It is therefore supposed that one of the species was of large size and another one small.

The *Naturalist* says: "We think on such a basis, we could infer several species of *Homo* on the North American continent, but as zoologists and paleontologists, we must decline to admit such unsubstantial visions within the Walhalla of species and genera."

PAUL BROCA.

THIS distinguished physician, whose researches in anthropology have given him a world-wide fame, died suddenly at Paris, July 8, in the fifty-sixth year of his age. He was born at St. Foy, in the Gironde. At the age of sixteen he was already bachelor of mathematical sciences, and was about entering the Polytechnical School, when, at the desire of his father, he abandoned this project and entered upon



PAUL BROCA.

the study of medicine. At the age of twenty-two he became assistant professor of anatomy, and subsequently professor of surgical pathology. He soon acquired a high reputation by his researches in cerebral pathology, and continued to devote himself with great zeal to hospital work and clinical teaching to the last; but his great fame rests chiefly on his researches in anthropology—a subject that he had made entirely his own, and in the study of which he occupied a position that will not soon again be filled. Twenty years ago the science of physical or anatomical anthropology was in its infancy, and all investigations were at variance even as to the methods to be pursued in its cultivation. Broca devoted many years of unceasing activity in endeavoring to define, systematize, and perfect these methods. The thoroughness and energy with which he threw himself into any research which he undertook were marvelous, and only equaled by the clearness and facility of expression with which he communicated his results to others. His series of essays on various subjects connected with craniometry, published in successive numbers of the "Memoires of the Société d'Anthropologie of Paris," and the *Revue*, which he founded, and his "Instructions Craniologiques et Craniometriques," with the introduction of numerous neat and happily-chosen terms for descriptive processes, have caused an immense advance to be made in the progress of the science. Happily, Broca's perfect simplicity and amiability of character, his pure love of science for its own sake, and his readiness to help those engaged in pursuits similar to his own, have inspired with enthusiasm all those who came in contact with him; and he has created at Paris a school which it is to be hoped will carry on the work he inaugurated.

FURTHER INVESTIGATIONS OF PROF. JAEGER REGARDING CLOTHING IN ITS RELATION TO HEALTH.

THE following is an extract from a lecture delivered by Prof. Jaeger before the society "Hahnemannia," at Stuttgart, and which was published in the *Homeopath. Monatsblätter.* It may be considered a continuation of a previous article on this subject contained in SUPPLEMENT, August 28, 1880.

The lecturer said that, twelve years since, when he received the appointment of Prof. of Anthropology at the Polytechnicum at Stuttgart, it then became evident to him, for the first time, that the knowledge of those conditions upon which health depends was at a very low stage, and that science thus far had made but small endeavors to explain why human health in general is so feeble in comparison with that of the animals of the field and forest. He had not been able to believe that this feebleness of health, was an original institution of nature, but had come to the conclusion that it was caused by errors and mistakes in the manner of dress and mode of living. This led him, deviating from the usual method of investigation, which deals only with the external influences to which the body is subjected—to make an effort to determine in what condition the body has to be, in order to be able to resist those obnoxious influences which, as we well know, cannot be always avoided.

The fact that gymnastic exercises increase the resistibility of the body, led him to the investigation of the changes which the different organs of the body experience in consequence of these exercises. He found by means of the chronoscope, first, that by bodily exercise the conductability of the nerves was greatly augmented, and secondly, that if this exercise is continued until perspiration ensues, the beneficial results are still greater. Statistic tables of the Stuttgart public schools, in which the cases of the absence of children from school on account of sickness is recorded, showed that since gymnastics have become obligatory in schools these cases have been diminished 20 per cent, and that in those schools where these gymnastics were treated by a method which produced perspiration, the number of these cases was still diminished 25 per cent. more.

This discovery led Prof. Jaeger to the persuasion that the diminution of the quantity of water contained in the body, and which diminution is brought about by the perspiration, is the point of chief importance. This opinion was corroborated by experiments made with vapor baths. In four persons, one vapor bath was sufficient to increase the conductability of nerves 13 per cent. A further proof for the correctness of this view was given in the results of measurements which Prof. Jaeger made with a company of soldiers, the original object being to ascertain the influence which gymnastic exercises had upon the lungs. These measurements showed that by the continual bodily exercise the body of the soldiers receives a greater specific gravity. This specific gravity of the soldiers during the second year of their enlistment is 18·7 per cent. greater than that of the first year, and that of the third year is 12 per cent. greater than that of the second year. At first the author determined the specific gravity by calculating the cube containings of the body by means of its circumference, but later he used a large cylinder of sheet-iron filled with water in which the person to be measured was submerged and the volumes determined by the rising of the water in a tube connected with this cylinder. (He intends for further experiments to use an apparatus in which compressed air is to be employed.) Two hundred and fifty measurements in this manner verified the previous result, viz., the increasing of specific gravity by gymnastic exercise, and the question was now to ascertain in what manner this increased specific gravity influenced the general state of health. For this purpose he examined the statistical record containing the cases of sickness in the German army, and discovered that the general state of the health of the soldiers corresponded exactly to the specific gravity of their body. During the first year of enlistment the death rate is 50 per cent. greater and in the third year 34 per cent less than in the second year, and although the number of discharges given in the first year on account of disability is four times as great as that of the second year, this latter year still surpasses that of the third year by 45 per cent.

In comparing the different kinds of sickness occurring among the soldiers, Prof. Jaeger discovered that not only the cases of colds but also those of contagious diseases, especially those of fever and cholera, decrease in the same degree each year during the three years of service There fore a decrease in the quantity of water contained in the human body renders it (*seuchenfest*) able to resist contagious diseases.

An explanation of these facts, the professor said, was given to him in reading a treatise of the well known botanist Prof. Naegeli, of Munich, in which are contained experimental proofs that the fermentation of the putrefaction of a liquid may be rendered impossible by a diminution of the quantity of water contained in it. Prof. Jaeger came at once to the conclusion that the same law would hold good in regard to the liquids of the human body. The above named experiments proved that he was correct, and led him to the discovery that an increase of specific gravity renders the body more resistible against contagious diseases, and this discovery was at once acknowledged by high scientific authorities in Germany and especially by Prof. M. v. Pettenkofer, of Munich.

The next step was now to find a practical application of the results thus obtained, and different means were used by him in order to decrease the quantity of water contained in the body. Vapor baths, sudorific medicaments, energetic gymnastic exercises, etc., produced a temporary decrease in the quantity of water, but they were insufficient for a permanent result. However he finally accomplished this by changing the material and form of his clothing. It is well known that the perspiration through the pores of the skin is facilitated by a perfect circulation of blood, and according to the laws by which this distribution is regulated, he determined to use clothing by which chiefly are warmed the hands, the feet, and the front middle-line of the body. For this purpose he commenced to wear double-breasted coats, and tried in the heat of summer to keep on the same kind of clothing which he used in winter, and which consisted only of coat, woolen shirt, and pants. During these experiments he found that he felt perfectly comfortable even in great heat in one of his coats, which was lined with flannel, while those which were lined with other materials became burdensome in hot days. This induced him to have all cotton-lining removed from his coats, and the success of the trial was perfect. Although Prof. Pettenkofer had already made experiments with woolen clothing, Prof. Jaeger at first was unable to explain why it was that by this improvement of his clothing, which now consisted of animal wool only, his general feeling and his health were so greatly improved, but he finally explained the reason of these beneficial effects by the experiments regarding the volatile substances in the human body which we mentioned in the previous article.

A NEW NARCOTIC.

A VALUABLE narcotic has recently been found in the Jamaica dogwood (*Piscidia erythrina*), and is obtaining very favorable notices from our medical exchanges. The tree belongs to the natural order *Leguminosæ*, and grows in Jamaica in arid districts. The active principle is contained mainly in the bark of the roots. The drug is stated to be a direct sedative, producing narcotic effects which are refreshing, and not followed, as in the use of opium, by hyperæmia of the brain, nausea, and general nervous disturbance. Dr. Isaac Ott has recently studied experimentally its physiological action, and published the results in the *Detroit Lancet* for June.

As the active principle has not yet been eliminated, he used in his experiments an infusion, obtained by mixing an ounce of the fluid extract of the bark with an equal quantity of warm water and evaporating the whole down to about five drachms, the object being to get rid of the alcohol. His experiments show that we have in piscidia a drug capable of producing death by arrest of the respiratory apparatus. Frogs seldom recover from a moderate dose of the drug. The following are some of the conclusions drawn from the experiments: Piscidia is narcotic to frogs, rabbits, and men. It does not affect the irritability of the motor nerves. It does not attack the peripheral ends of the sensory nerves. It dilates the pupil, but the dilatation passes into a state of contraction upon the supervention of asphyxia. It salivates; increases the secretion of the skin; and reduces the frequency of the pulse. It increases arterial tension, this being succeeded by a fall due to the weakening of the heart itself. If its action be compared with that of chloral, it is found that it has no such dangerous action on the heart as the latter, nor such an energetic action on the respiratory apparatus. Unlike atropia, it does not paralyze the motor nerves nor the chordæ tympani, does not arrest the sudoral secretion, does not paralyze the pneumogastric, and does not elevate greatly the arterial tension; like atropia, it dilates the pupil. Like morphia, it produces sleep, heightened excitability, spinal convulsions, general paralysis, and stimulation of the main vaso-motor centers; unlike it, it dilates the pupil. Several cases have been reported lately in which piscidia was used successfully as a substitute for opium in the treatment of various neuralgias. A writer in the *Therapeutic Gazette* says that the sleep produced by it is tranquil and refreshing, and free from dreamy sensations.

TWO VICTIMS OF A RARE DISEASE.

IN the Franklin County Infirmary at Columbus, Ohio, are two boys, brothers, one twenty-one, the other nineteen years of age, who are afflicted by a strange disease, characterized by a wasting of the flesh of the body while the head remains unaffected. In giving an account of the boys and their case to a correspondent of the Cincinnati *Commercial*, Dr. Drury, of the infirmary, said that they were of German parentage, had been in the Infirmary seven years.

Both boys lived and grew like ordinary boys until they were eight years of age, when the first symptoms of the disease with which they are afflicted were developed. The progress of the disease was precisely alike with both boys, and the description of either one is a description of the other. Dr. Drury, in describing them, spoke of Frank, the younger one, because he has observed him through all the stages of the disease thus far developed. The first symptoms of the disease is adiposity, accompanied by muscular weakness.

When Frank came to the infirmary he was plump and fat and looked extremely healthy, much like fat boys seen in side-shows. He played with the other children about the house and yard, but he would fall down constantly. He was very sway-backed and would waddle about like a duck. His falls became more and more frequent, and in about a year he became bedridden. Then the flesh and muscle degenerated and began to grow thinner and thinner, until now they are mere shreds, and he has no strength whatever. The muscles about the mouth of Charley are already absorbed, and there are great hollows on each side of the mouth. Dr. Drury thinks that it is a mere question of time when the muscles and flesh of the face will disappear, and eventually the muscles of the chest, when the boys will die because of inability to keep the respiratory organs in motion for want of muscles to raise the chest.

The disease is regarded by physicians as having three stages. The first, muscular weakness; the second, muscular pseudo-hypertrophy; and third, atrophy, or decay of the muscles. It is called "pseudo-muscular hypertrophy." The distinguished scientist, Hammond, in his "Diseases of the Nervous System," says that but seven cases of this kind are upon record. The origin of the disease is as yet unknown. Physicians, however, have two theories, but neither has been satisfactorily established. One is that it is a disease of the muscles, while the other is that it is a disease of the spinal cord. Certain it is, however, that the disease originates from a weakness or abuse of the nervous system, as in the case of these boys, their father being a dissipated man, and their mother having died insane. The disease seems to run in families, although the cases are so rare that it cannot be termed hereditary. It is confined entirely to boys, and as in these cases, never develops until the boys are seven or eight years of age, and in the majority of cases the victims to this most terrible disease have been children of well-to-do parents. The brain and organic functions are never affected. These two boys eat regularly three times a day, and their appetite is good. They eat about the same quantity as other boys.

THE INFLUENCE OF ALTITUDE WITH REFERENCE TO THE TREATMENT OF PULMONARY DISEASE.

The author, William Marcet, M.D., F.R.S., accepted the generally acknowledged theory that cases of phthisis among the inhabitants of altitudes exceeding five or six thousand feet were so rare as to be exceptional. He also admitted that such winter stations as Davos might prove beneficial to consumptive invalids, and had in some cases apparently effected a cure. After reviewing the influence of altitude in disease with especial reference to the various descriptions of pulmonary affections, the author proceeded to account for the beneficial effects of such winter stations as Davos on consumptive invalids. He stated the results of his own experiments on respiration at various altitudes, which had a direct bearing on the present subject, and from which he arrived at the following results:

1st. At stations at various altitudes above the sea, a smaller weight of air was taken into the lungs (or a smaller volume of air reduced to seaside pressure and freezing point), while more carbonic acid was emitted, especially in a cold climate; and it followed that the oxygen of the air passed through the substance of the lungs into the blood more rapidly or more readily on mountain stations than near the sea level. 2d. Up to 7,000 or 8,000 feet the increased volume of air breathed within a certain time (not reduced) was due to a greater expansion of the chest and lungs, and but little, if at all, to an increased rate of breathing, although at higher stations the frequency of the respiration was decidedly increased. The author concluded that the beneficial influence of high winter stations on the progress of phthisis was due: 1st. To the blood becoming more fully charged with oxygen from the air breathed, and to the phenomena of oxidation in the body being increased, thereby promoting considerably the healthy changes in progress in the living body; 2d. To the capacity of the chest and lungs being increased—at all events, temporarily—after a winter sojourn in the mountains; and because, on that account, a greater volume of air was breathed after returning to a lower level. This last conclusion was arrived at independently of the observations and statements made by Dr. C. T. Williams, who offered a similar explanation to account for the beneficial influence of Davos in cases of phthisis.

GALLOPING CONSUMPTION.

T. M. MCCALL ANDERSON, M.D., read a paper on this subject before the recent meeting of the British Medical Association. By the term acute phthisis the author meant an acute pulmonary affection, accompanied by high and continuous fever, running a rapid course, and leading invariably to more or less destruction of lung tissue if the patient survived long enough. He recognized three varieties of the disease: 1. Acute pulmonary tuberculosis; 2. Acute pneumonic phthisis; 3. Acute pneumonic phthisis complicated secondarily with the development of gray miliary tubercles. He thought it impossible to distinguish the second from the third variety during life; but that the first might be suspected when the disease set in suddenly with high fever, great prostration, profuse perspiration, lividity, and great acceleration of breathing, and when these symptoms were *out of all proportion to the results obtained from a physical examination of the chest.* Having given extracts from the writings of Walshe, Trousseau, and others, showing that the profession was very hopeless as to such cases, he pointed out that, in a good many cases, he had obtained excellent results from treatment of which the following was an outline: 1. Careful skilled nursing, with constant feeding, and stimulants in small quantities often (from four ounces to ten ounces daily); 2. Each night, a subcutaneous injection of one-hundredth to one-sixtieth of a grain of atropin; 3. Remedies specially adapted to the removal of fever: (*a*) ice-cloths to the abdomen; (*b*) quinine, ten to thirty grains, in a single dose, once daily; (*c*) a pill, composed of one grain of quinine, half a grain of digitalis, and from a quarter to three-quarters of a grain of opium, every four hours. In addition to this, special symptoms—diarrhea, constipation, and the like—must be treated on ordinary principles, and, of course, the treatment indicated must not be used in a mere routine way, but adapted to the surroundings of each individual case.

BRIGHT'S DISEASE.

DR. GAIRDNER had been long of opinion, as the result of more than twenty-five years of hospital experience, that the English practice in Bright's disease, and especially in acute and sub-acute cases, had been too much founded on the conception that the kidney, like an inflamed organ, must have, as nearly as might be, entire physiological rest; and hence that diuretics were to be avoided, even at the risk of their requiring to be replaced by more perturbatory practice. Dr. Gairdner did not hold that diuretic treatment was alone sufficient, or even in all cases expedient; but he held that the mere abstinence from diuretic treatment, or the doctrine that such practice was to be regarded with suspicion in the cases in which the simpler saline diuretics could be brought to act, was opposed to the teaching of experience. In the London schools the teaching adopted for many years was that the occurrence of active diuresis, under remedies especially adapted to that end, was to be avoided, and that it was better practice in most cases, and especially acute and sub-acute cases, to aim at purging the bowels continuously by the strongest and most irritating cathartics, than to give scope to the kidneys to respond gradually and gently to such remedies as cream of tartar, potash salts, and digitalis. The position here referred to had been modified of late years by the admission: 1st. That spontaneous diuresis often, if not invariably, occurred in such cases as a kind of crisis, or as a first step in the cure; 2d. That (as Dr. Dickinson, in particular, had emphatically taught) the copious imbibition of "clear spring water," in quantities such as to make it practically one of the most active of diuretics, tended to the relief rather than to the obstruction of the kidney in its physiological work; in other words, that flushing of the obstructed tubili uriniferi, and general furtherance of the true physiological activity of the kidney tended (as Dr. Christison long ago showed) to the diminution of its pathological disturbance of functions, as indicated by albuminuria, deficient excretion of urea, and dropsy. Dr. Gairdner regarded it as in accordance with clinical experience, apart from the theory that, whenever the simpler diuretics would act at all in such cases as were usually treated by means of elimination, their action should be furthered and encouraged in preference to other modes of elimination. While he did not at all discountenance the use of purgatives on the one hand, or of diaphoretics on the other, in cases in which they were specially indicated, or in which diuretics could not be brought to act, he was always disposed to make such simple diuretic practice as was indicated above the keystone of the treatment, and to consider it as more in accordance with nature, and with the spontaneous tendency to crisis above mentioned, than the use of the stronger drastic purgatives, or even of medicinal diaphoretics, or the too-repeated and somewhat enervating use of warm baths, or of air and vapors at a very high temperature. Diuretics, indeed, not unfrequently failed; but so also, not unfrequently, did all the other remedies mentioned It must also be admitted that the reasonable regulation of the skin and of the bowels was an essential part of good treatment in most cases of Bright's disease, whether attended or not with dropsy, and that in certain cases, *e. g.*, of immediately threatening uræmia, drastic cathartics were sometimes the only method that could be trusted for immediate relief. In such cases

Dr. Gairdner acted on the presumptions derived from Bernard and Barreswil's well-known experiments, as well as on empirical data, showing that the elimination through the bowels of excretory matters, which, if retained, were dangerous to life (and notably of urea and its congeners in the form of carbonate of ammonia), might be rationally and safely accomplished for a time, at least, so as to save life and conduce to present comfort. But he regarded this perturbative course as only a temporary phase of treatment, necessary in some cases, and to be supplanted as soon as possible by the more natural and physiological determination of the liquids toward the kidney.

By the judicious use of formulæ by no means complex, it was usually possible to graduate catharsis into diuresis, so to speak, in such a way as to gain whatever advantages resulted from the former practice, while at the same time seizing the earliest opportunities of inducing a true renal crisis, whereby the cure, if possible at all, was usually best completed. The exclusively diaphoretic practice of Dr. Osborne, of Dublin, seemed to have been tried and found wanting, and, in a measure, laid aside, until recently revived in another form in Germany, particularly by Bartels, whose admirable articles in "Ziemssen's Cyclopædia" would probably give rise to new elaborate trials of Turkish and vapor baths. Dr. Gairdner had often employed these with benefit; but he thought that these benefits would be exaggerated if they were so employed as to shut out diuretics, or to divert habitually all the available liquids of the body for long periods together to one emunctory, and so to starve the supply of liquids to the kidney. In a few cases of great obstinacy, however, a certain amount of temporary benefit appeared to result from the hypodermic employment of pilocarpin in doses of one-eighth to one-fourth of a grain every second day. The limits of expediency in the use of such perturbative and medicinal diaphoresis had, however, to be determined by careful further researches. The same remark applied, in Dr. Gairdner's opinion, to bloodletting, which, at one time a frequent and even a very favorite remedy in the acute and sub-acute cases, had in later years almost gone out of date, but which had been yet more recently revived by several observers and practitioners of good standing.

THE WOURALI POISON.

MR. MONTAGUE FLINT, F.R.G.S., in *Temple Bar*, gives an account of the circumstances attending the preparation of wourali by the Macusis of the Canuca Mountains. The people of this tribe say they are the sole patentees of this subtle and renowned poison; and even of the Macusis only a few know how to prepare it. It is accounted a great secret, and is imparted from father to son or next male heir when the former is believed to be at the point of death. The process of manufacture is carried on on comparatively rare occasions, and is surrounded with great solemnity. For ten days previous to the first boiling down, all the men who are to take part in it are supposed to fast, and all the women of the tribe are carefully kept out of the way. The long arrows the natives use with the bow are sometimes dipped in the poison, and a small tube of bamboo placed over the tip to prevent any one being accidentally pricked by it. The blow-pipe arrows or shafts, mentioned by Waterton and others, are thin slips of hard wood, made from the stem of the leaf of the cucurite palm. They are generally from twelve to eighteen inches in length, sharpened at one end, and wrapped round at the other with common cotton, or with the brown silklike cotton of the silk-cotton tree. The sharp points are dipped in the wourali, which is of the color and consistency of melted glue. These they carry in a wicker case, shaped like a dice box, but larger, very closely woven, and with a leather top and bottom, the top opening on a leathern hinge. The length of the blow-pipe itself varies from twelve to fifteen feet. Thus equipped, they range through the forests, shooting monkeys, birds, or such other animals as come in their way. The only antidote to the poison they are in the habit of using is a kind of earth worm, well known to them, and common enough in these parts. Should any of them be so unfortunate as to get scratched, a hasty search is made for some of these earth-worms, which are pounded together, a portion being used to anoint the wound, and the rest swallowed by the patient.—*Lancet*.

MEDICAL PROGRESS.

IN the introductory lecture of the fall course of the medical department of the University of the City of New York, Professor Alfred L. Loomis discussed the relations of clinical study to medical progress. The statistics of European and American hospitals, he said, show that human life has been prolonged more than twenty-five per cent. during the past seventy years, and that the treatment of diseases has been shortened more than one third. The causes which have led to this are: First, the discoveries which have given chemistry a controlling influence over all medical theories. Second, the rapid progress that has been made in chemical, microscopical and experimental physiology. Third, the increased attention paid to microscopy, by which the mode of development of cells, the arrangement of their nuclei and nucleoli, the organization and growth of the different tissues, and the processes of repair and decay, have been investigated. Fourth, the study of morbid anatomy, not only as regards the various degrees of pathological development and the relation they bear to each other, but their connection with disease. Lastly, the new and more perfect modes of clinical study, by which discoveries have been made which have changed and entirely revolutionized this branch of medical science, giving it a degree of certainty which at one time seemed hopeless. No one will question that advance in practical medicine rests upon the power of correct diagnosis; consequently all of those means which enable one to become more exact in clinical investigation are especially important.

The professor showed that during the existence of the Asclepedean school, with Hippocrates at its head, clinical study formed the basis of all medical investigation. It was during this period that medicine was established on a scientific basis; but after the dissolution of this school clinical study and teaching declined altogether and medical progress was arrested. About the middle of the seventeenth century, Sylvius, at the University of Leyden, restored clinical teaching, and began systematic clinical study, but at his death it declined, and medicine was again filled with superstitious vagaries. There is no record of any advance in medicine until the close of the eighteenth century, when Boerhave practiced again the methods of Hippocrates, and established his clinic in the small hospital at Leyden, and clinical chairs were established in the Universities of Rome, Edinburgh, and London. In 1795, Corviso, who occupied the chair of clinical medicine in Paris, by his successful teaching, gained for Paris a reputation which she enjoyed as the center of clinical study in Europe. Thus the careful student of ancient medical history cannot fail to observe the close connection between medical progress and clinical study. One of the most important discoveries which wrought a radical medical change in the method of investigating disease, was that of auscultation, by Lauence. The labor necessary to perfect this discovery and develop it into a complete system was arduous; each step was carefully taken, and no system of investigation or series of clinical observations has ever been presented to the profession that has so thoroughly stood the test of other investigators. To-day it is no equivocal answer which the skilled auscultator gives the troubled inquirer as to the condition of his thoracic organs. It has enabled us to reach positiveness in our diagnosis of thoracic disease, and to detail from day to day the changes which these organs undergo during the progress of the disease.

Such power has tended more than anything else to place medicine on a higher plane of development. Dr. Bright opened wide a new field in the discovery of those diseased conditions of the kidneys which to-day bear his name. He was eminently distinguished for his philosophic truthfulness, and would never permit the slightest bias to be given to any clinical observation in order to favor any pretended view or opinion, and there have been few, if any, who have observed and recorded so much, and have reasoned so extensively upon their observations, who have been required to retract so little. The crowning work of Marshall Hall was his discoveries in the diagnosis of nervous diseases. He overturned all the existing theories in regard to the pathology and physiology of the nervous system. The true idea of a nerve center could never have been said to exist before the time of his discoveries. He established the reflex function of the spinal cord, and first demonstrated the three great classes into which the various parts of the nervous system resolve themselves. Since the principle of achromatic correction was first brought into efficient operation in the construction of the microscope, it has become practically a new instrument. Among the most important changes wrought by it was the complete revolution in the ideas previously entertained regarding vital action. It had been based on the circulation of the blood, but it now became evident that in animals, as in plants, each integral part possesses an independent life of its own, and performs a series of actions peculiar to itself, and that the life of the body, as a whole, consists in the harmonious combination of its separate instrumental acts. The effect of the introduction of such an instrument into the clinical study of disease cannot be estimated, and when we add to this the ophthalmoscope, the laryngoscope, and the long list of physical aids that are furnished to the clinical student of the present day, we find a ready explanation of the rapid advance made in practical medicine; and it could be shown that clinical education has been the companion, if not the source, of the wonderful progress that has been made in the other departments of medical science.

The lecturer impressed upon the students the fact that the most important and growing work of their medical pupilage was their clinical education. An important principle in clinical study is to classify clinical facts according to their importance. The student must be fascinated with the study of disease; he must feel an almost irresistible attraction to the bedside of the sick. The special senses must be cultivated to the highest degree, and skill can only be acquired by constant and unwearied exercise; by carefully watching the methods of a skilled teacher over and over again. The eye, the ear, the touch, however sharp and delicate they may be, require a special course of training before their evidence in the investigation of disease can be trusted. The student must be impressed with the fact that work is the first and greatest element of success in all departments. The professor advised the student to work at difficult things; easy things would take care of themselves. Begin to-day, he said, to work with the clear conviction that human life will depend upon what you do and how you do it. Work as you would have another work, if your life depended upon his exertions. It requires no less courage, endurance, or self-sacrifice to save another's life by means of knowledge than in case of fire or any such danger.

HOW THE METRIC SYSTEM HAS BEEN GETTING ON.

A CALM survey of the field during the past summer leads to the conclusion that the extraordinary dash with which the metric system rushed into the arena a year or two ago, in this country, was a false start. A certain number of youthful doctors took it up with zeal, just as they do the new remedies which are boosted every month or two; a certain number of old doctors bored themselves greatly by learning and using it, for fear they would be called old fogies by their younger competitors. Several medical journals and one or two publication committees of State societies passed decrees violently expelling those old friends the ℈, ʒ, and ℥ from their pages. A huge reform was immediately to be inaugurated and carried by a sweeping vote.

A perceptible cooling off has followed within the last six months. The medical journals alluded to have quietly readmitted the banished old friends on divers occasions, and the metric doctors, young and old, are shocked to discover that their impetuous welcome to the French stranger may possibly have been misplaced, and is not likely to be shared by their compatriots in the profession.

To show the justice of this opinion we shall quote the words of various esteemed contemporaries, which will indicate conclusively, we take it, that the tide has turned, and that we had better drop the effort to force into prescription writing the method so hotly urged upon us.

The Detroit *Lancet* has put very strongly the fact that the meter is not only an arbitrary, but a confessedly erroneous standard. It quotes with approval the expression of the eminent astronomer, John Herschel, to the effect that the "production of the meter was not a blunder only, it was a sin against geometrical simplicity. It was a sin, because in the earth's axis they had a straight and unvarying line."

This is a knock-down blow from an authority which it were vain to question. It puts an end to the metrical system's claim to be based on an invariable natural relation.

From the same quarter the Michigan *Medical News* speaks in equally decided terms. In its issue of August 10 we read:

"The advocates of the metric system are very persistent in their efforts to foist it on the profession. In season and out of season they are advocating its claims, and urging that it supplant the system of weights and measures now in use. They have succeeded in achieving for it a foothold in the coming decennial Pharmacopœia—a foothold which, unless care be exercised, will result in a repetition of the camel's intrusion in the fable. There is no objection to its employment in pharmacy, that is, for the purpose of manufacturing, but to introduce it into the dispensing of drugs will be to cause great confusion.

"The simplicity of the metric is urged. This is an illusion. It admits of but one bisection, and then a complexity begins, from which only a specially endowed mathematical mind can extricate itself with any degree of certainty."

This last point has been well developed in the Atlanta *Medical Journal* by Dr. C. W. Erwin. It is psychologically true, and the result of all experience, that the mind conceives more easily a quantity expressed in a few large units than in many small ones. The distinctions of coinage all recognize this. Why have dollars when one could speak of hundreds of cents; why cents when we could speak of thousands of mills, except for this obvious reason? Dr. Ennis' remarks are as follows:

"No system should take precedence of the old that is not, first, as accurate; second, as easily and quickly calculated; third, does not express weight, quantity, bulk, or measure; present to the mind as rapidly and, as nearly as may be, the exact appreciation of the quantity, weight, or measure expressed by the numbers.

"It is not only necessary to calculate by arithmetic the vulgar or decimal fractional part of any unit of measure, but when the answer is called the mind should grasp the idea of the actual quantity or bulk expressed by figures.

"Now we contend that the lower the numbers and fewer the figures the more readily the mind takes in the idea. For this reason experience has taught us when figures expressing quantity, weight, or measure become too numerous, it is best to resort to lower figures of a higher denomination."

The *Western Lancet*, San Francisco, observes:

"It is an astonishing fact that, in looking over medical literature for a year or two back, we find so few objections to the system, when it is so manifest that such a system, if adopted into our text-books, will render the reading ambiguous and tangling, unpractical and unused; subjecting the entire text book to the caprices of an unnatural regime."

The *Medical Annals*, Albany, in the June number, set forth strongly the inaccuracy of the system, and distinctly avowed their determination not to adopt it.

The *Medical Herald*, of Louisville, calls the whole system "an absurdity," and praised the Association of Medical Editors that they had declined to recommend it.

Meanwhile the American Medical Association, at its late meeting, recommended the adoption of this system, and is endeavoring to force its adoption by medical colleges, medical and pharmaceutical institutions, and by medical men. Its committee is to report all medical colleges who do not adopt it.

Of this action Dr. Gaillard writes, in his *Medical Journal*:

"The whole effort will be an absolute failure. Nothing less than a law making its adoption imperative by the representatives of all avocations using weights and measures can secure its use by physicians. It is idle to use resolutions and reports for this purpose. It is courting failure."

This inconsiderate action of the American Medical Association has very naturally developed opposition. It is rather too much to have an awkward and erroneous system thus crammed down the throats of the profession, will they, nill they. This opposition has crystallized itself into the form of an "International Institute for Preserving and Perfecting Weights and Measures." Branches of this society have been organized in Boston, Cleveland, Pittsburg, and elsewhere. Charles Latimer, of Cleveland, has written a pamphlet on "The French Metric System," published by Thomas Wilson, 188 Monroe street, Chicago, which claims to show that the time and place of the French Revolution and the worship of the Goddess of Reason did not produce a metric system worthy of adoption by the world.

For our own part, we have, as readers will remember, never advocated the forcible introduction of the metric system into prescription writing. Societies and journals travel widely beyond their proper spheres in trying to force their members and correspondents to use it. It is at best of questionable accuracy; it is more likely to lead to errors in compounding; it is less rational than the present method, and it is more difficult to comprehend and use. Its only real advantage is its decimal notation, and we can get that without resorting to it.—*Med. and Surg. Reporter*.

PLANTS IN LIVING ROOMS.

THERE was once, and there probably still is, a superstition that plants kept in living rooms are unwholesome. Setting aside special cases, it may be said, as a general rule, that plants in a living room, if they have any perceptible effect at all, are decidedly beneficial. This is the view of the subject taken by Dr. J. M. Anders in an article published in the Philadelphia *Medical News*. Dr. Anders points out the fact that the three chief functions in plant-life are the absorption of carbonic acid, the exhalation of oxygen, and the generation of ozone. Now, it has been conclusively shown that variations in the amount of these gases from the presence of any number of plants have no appreciable effect on the air of the apartment, the absorption and exhalation of these elements being carried on too slowly either to improve or to vitiate the air. But there is yet another process going on in plants, which, from a hygienic stand-point, is of far greater importance—that of *transpiration*, or exhalation of moisture by the leaves, and which is of invaluable service in rooms warmed by dry air furnaces. The amount of such moisture given off by plant foliage has been carefully studied by Dr. Anders, and the results have formed the basis of some articles published by him last year in the *American Naturalist*. In the article under consideration, the author, after citing a number of cases, draws these conclusions: "It will be seen that what we have deduced from experimental results concerning the health-giving effects of plants (which is owing to transpiration increasing the humidity of the air—the plants acting as natural and perfect 'atomizers') is entirely in harmony with what is observed concerning the effect of sufficiently warm air in many cases of phthisis; and if it is true, as we have attempted to demonstrate, that house-plant hygiene constitutes a valuable preventive measure where there is hereditary tendency to certain diseases, then it ought to be definitely and thoroughly understood; and it is of vital importance that it should be adopted in cases where there is known predisposition to phthisis, for half of the cases are supposed to be preventable, whereas if the disease be allowed to develop, complete recovery is not to be expected. Furthermore, though the keeping of plants does not 'cure' confirmed cases of phthisis it is nevertheless very useful to prolong life, and by ameliorating the distressing symptons it renders existence at least endurable—an office not to be despised in such a widespread and lingering disease." Dr. Anders goes further, and states that the pursuit of gardening, though naturally it favors rheumatism,

appears to arrest consumption in persons of phthisical tendency, while the abandonment of the pursuit in other cases observed by him led to the development of the disease. As a complete and agreeable health resort free from the inconvenience of traveling and the anxiety of separation from home, he recommends a room well stocked with plants.

CHEMICAL GENERATORS OF COMBUSTION.

THE following are apparently inoffensive substances which become very dangerous under certain circumstances:

Chloride of nitrogen, formed by the addition of chlorine to ammonia, is liable to explosion when put in contact with phosphorus, arsenic, turpentine, olive oil, etc. Iodide of nitrogen, produced by a mixture of ammonia with iodine, is also liable to the same consequences when in a similar contact.

A violent explosion was produced in England recently by concentrated solution of iodine and iodide of potassium after filtration. Concentrated solutions of permanganate of potash in alcohol may explode, and bichromate of potash may ignite the latter.

Aqua regia (nitro-muriatic acid compound) will cause explosion when mixed with alcoholates or essential oils.

Chlorate of potash, in combination with dry tannin, is dangerous, and may generate combustion or explosion when placed in contact with a muriate. Dyed goods excessively impregnated with these elements are liable to spontaneous combustion under certain contingencies.

The following ingredients could not be reduced to powder by heat without risking an accident: Chlorate of potash, sulphate of antimony, milk of sulphur, and solution of zinc.

Ignition has been produced by nitrate of silver, added to essence containing hydrocyanic acid. Accidents of a serious nature have been caused by the compound of hyposulphite of lime, chlorate of potash, and oxide of iron. The simple trituration of hyposulphite of lime has sometimes resulted in mischief. A man was killed in Germany while drying this salt in a silicious desiccator.

Glycerine and chromic or nitric acid produce the well-known and dangerous nitro-glycerine. An explosion can be generated by a compound of perchloride of iron, chlorate of potash, and glycerine. Oxides of silver, or of any metal, in combination with azotic matters, may generate fire. Combustion is naturally latent in substances containing an excess of permanganate of potash and iron, golden sulphuret of antimony, and chlorate of soda. Any deoxidizer, as glycerine, associated with reducible agents, such as chromic acid, chlorates of potash, or any organic, is naturally dangerous.

All these agents of heat and combustion are more or less employed under various forms, direct or indirect, in many industries.

A CALIFORNIA ARBORETUM.

THE new residence of ex-Governor Stanford, at Menlo Park, California, will be surrounded by 450 acres of ground devoted to an arboretum, intended to be the most elaborate and comprehensive in the world. As described by the San Francisco *Chronicle*, the land in the vicinity of Menlo Park is generally flat, and thus, although on many of the estates there money has been lavishly expended in the adornment of the grounds, there is a lack of that artistic finish and effect that can only be produced on undulating soil. In the case of this residence, however, the plans are so laid out as to take every advantage of the undulating ground to improve the aspect, and at the same time to give a series of fine views through the seven broad vistas that converge toward the mansion. Last season the ground for this year's operations was surveyed and mapped out, and the space, comprising some 80 acres, was prepared. In the first place, a mass of eucalyptus were planted, in order that, through their rapid growth and dense foliage, they should afford shelter to the more valuable plants, especially to those that, coming from the East, are not yet acclimated. These will be gradually removed to give place to those rare exotics that are to be brought from every part of the world. The first consignment this spring consisted of 4,000 plants and cuttings, representing every known specimen of California arboriculture suited to the soil, comprising altogether some 120 varieties. Many of these, chosen from our best nurseries, were already in the shape of small trees, and in planting them an ingenious contrivance was made use of to insure success, and, at the same time, facilitate the operation. Previous experiences on the old grounds had proved that the ordinary method of digging a hole some four feet deep and then filling it up with soft earth and manure was faulty, as, when the rains came on, these latter absorbed all the moisture, the sides of the hole having become as impermeable as a hard clay wall; the stagnant water soured the earth, and the roots of the plant, being unable to pierce their confines, gradually collapsed from want of sufficient nourishment. So now a different and novel plan is adopted. One man goes in front and drills a slight hole of two feet in depth; a second follows with half a cartridge of nitro-glycerine, which a third discharges, and the result is that the soil is rent asunder, the fissures leading in all directions, thus insuring a good nourishing bed for the plant. This is a great factor toward the success of the plans, and greatly facilitates the labor on the plantation, and it also allows a thorough examination of the soil that is so requisite in these experiments.

Early in March there arrived from New York nurseries several consignments of valuable Eastern and foreign trees. There were in all 3,600 specimens, comprising 340 varieties, 300 specimens of azaleas, rhododendrons, and camellias, and of which there were 118 varieties. Naturally, it would be impossible to give a detail of all these trees, filling, as they do, thirty pages of the stock book, and even if we had space their names would be strange to many of our readers, as they are almost all couched in the Latin language. Sufficient to state that they include every plant propagated at the East that is likely to add to the attractions of this unique park. There was also a consignment of fruit trees, 1,108 in number, and of 272 various kinds; and, as a sample of liberal enterprise, we annex the list of this latest addition to ex-Governor Stanford's orchard and fruit garden: 290 apple trees with 59 varieties; 12 varieties of apricots in 55; 4 of blackberries in 48; 32 of cherries in 64; 13 varieties of currants in 78 bushes; 4 of gooseberries in 48; 8 of mulberries in 40; 12 of nectarines in 63; 3 of nuts in 14 trees, including the celebrated English filbert; 45 varieties of peaches in 134 trees; 5 of Japanese persimmons in 27; 16 of plums in 46; 51 of varieties of pears in 153 trees; 2 of quinces in 12, and 6 of raspberries in 36, forming a total of 1,108 trees and bushes, composed of 272 kinds, and these simply for one year's planting, in addition to a great number of California growth, the improvement of which varieties is one of the chief aims of ex-Governor Stanford in his full and comprehensive plans. The ground is now being surveyed and mapped out for next year's planting, when not only will additional specimens be forwarded from England and the European Continent, but orders have been sent to Turkey, Africa, the East and West Indies, Mexico, South America, China, and Japan, to forward as soon as possible good cuttings of any trees that would be likely to succeed in our climate. Thus the great work will be continued, and it is believed that the park will be completed in three years, but even then additions will be made yearly to it.

OLIVE CULTURE.

THIS year, while so many other species of fruit trees seem to be suffering from disease, and yielding lessened crops, the olive, so far as heard from, is thrifty and vigorous. It seems to be as well adapted to our State as are our own native oaks and madrones. This fact should draw the attention of our horticulturists more closely to this famous tree, which, if extensively planted in California, would add greatly to our material wealth, and indeed create new industries and new occupations for children and adults.

Let us first see what foreign countries have done and are doing with olives, so as to realize in some degree what the future of this important tree may become in this State. In France eleven departments cultivate the olive, devoting a total area of 303,072 acres to that use. The total product of this land in oil amounts to nearly $12,000,000. This is exclusive of the pickled olives. In Italy, Greece, Spain, and Portugal large areas are devoted to the olive, probably in the aggregate greater than that of France, but statistics on the subject are not as full as could be desired. The fact, however, which appears most prominent, is that most of the olive product of European countries is required for home consumption, and that only the lower grades of pickles and the adulterated oils reach other markets. The olive groves of Europe are many of them century-old, and slowly wearing out.

With reference to the varieties of the olive more than fifty are named by French cultivators, but many of them are hard to distinguish from each other. The olive varies slightly under differing conditions of soil and climate. The departments of the Var and the Alpes Maritimes, France, contain half the trees grown in that country. In this region lemons and oranges thrive, there being no severe frost, and the olive, which is only destroyed by a frost of 15° or 14° Fahr., grows as large as a forest tree. At Monaco there are olive trees which are supposed to be coeval with the Roman Empire. In this same region the Carob, and the Australian Eucalyptus succeed admirably. This will give some clew to the climate. The summers are warm and rainless; the winters are mild. The soil is mainly limestone formation, with aluminous clays. Some hills are sandstone. Plantations are often seen on gravelly soils, and here the best oils are made. The soil must be dry, with a permeable subsoil. Red mountain lands are preferred in Italy. In France one of the best varieties cultivated is the *Le Caillet Olivier*, called also the *Neustral*, and known by many other names. It does best in strong soils on uplands, where there is plenty of air and sun, and is a great bearer, makes fine oil, and is the tree for the mountains. This variety is planted largely in Algeria, and is being introduced into South Australia. *La Blanquette* is a rounder olive, and prefers drier soils, standing heat well. An Italian variety, called *Le Calabrais*, is recommended for the most arid soils. *Le Brun* has dark wood, does not thrive in dry soils, and needs good culture. *Le Cayon* is the Hyéres variety, and is one of the hardiest, growing fast and succeeding in stony places. This and the first named variety make the best olive oil. In the Rhone district the *Aglandaou* or acorn-shaped olive, occupies the first rank. The *Sourine*, grown on the sea coast and on rich soils, is a famous kind for pickling. It averages twenty-two gallons of fruit per tree when full grown. It is a slow grower. The fruit is large, oval, black when ripe, and gives much oil, but of a poor quality. The *Verdale* is hardy, robust, an immense bearer, used only for oil. The celebrated Lucca oil of Italy is made from a variety called the *Frontoiana*. Calcareous soils are considered best.

The olive can be increased in many ways. The method mainly in use in this State has been from cuttings. A great difference is observable in different varieties as regards the ease or difficulty with which they strike root. One French writer says that the method of propagating cuttings is often too uncertain, but that pieces of wood one inch in diameter by a foot, sometimes grow. Olives are grown from seeds, and then grafted. This is recommended by the Italian Agricultural Society, as much the best plan. In 1874 their report said: "Sow in rows, in fresh ground, not too wet, but well sheltered, the stones without pulp, water when needed. Transplant the third year, and graft by the annular method in the sixth." But doubtless in California this time would be shortened. At Toulon they are grafted the second year. Another writer says: "Take thoroughly ripe olives of any variety, let them lie in water until the pulp is decayed, then rub the stones clean." The pits are then soaked in a caustic lye of lime and ashes, and buried deeply in the ground, kept somewhat moist, in the same way as peach pits are buried out in the autumn. When the rains begin they are planted in long rows. Another French nurseryman puts olive seeds in diluted sulphuric acid for several days before sowing. Choose the largest olives for seed.

Another method of propagation much used by nurserymen is from the knots at the base of the tree. The collar of an olive tree is peculiar. It is a mass of knots from which the trunk rises, and this mass, called a *souche*, grows easily when cut into pieces, as large as the palm of a man's hand, and two inches thick, with one surface covered with bark. These pieces, called *souchets*, are then put in rows in rich soil plowed deeply. Make a furrow eight inches deep, mellow the bottom of this ditch and plant the *souchets* a foot apart, covering them with four inches of earth. Then fill up the furrow with four inches of straw or leaves to shield the young shoots from heat. Water frequently and destroy weeds. Allow only two shoots to grow from each *souchet*. In large olive plantations many *souchets* are obtained from trees which are past their prime. The Lucca olive is nearly always propagated in this way.

Pruning of olives is a delicate task, if a good shape is desired. The first question relates to the height of the trunk, and three feet from the ground is the best. Give the head a vase form, exposing surface to the sun. Leave six or eight main branches. The olive bears only on the two-year old wood, and the pendent branches yield the most fruit. By pruning so as to form new wood each year, and also to reduce the number of fruit-bearing shoots, the olive bears annually, but a heavy crop will be followed by a light one. Winter pruning is much preferred. The sprouts from the base of the tree must be cut off. In some parts of France pruning is done once in two years. At Grasse the vase-like form is preferred; at Marseilles a globular shape; in Spain a portion of the tree is cut back every five years, and so it renews itself continually. There is much difference in the pruning required by different kinds. Dead wood and fruitless branches should always be removed. In Provence trees are grown so close to the ground that the fruit is easily gathered.

The ways of grafting the olive which are preferred are by crown and by shield grafting. In the former scions with buds which have started to grow are used. This method is adapted to old trees, and is applied to the trunk or large limbs by what is called side-grafting. Shield grafting is really a form of budding, a piece of bark with a dormant bud being used in the autumn. Young stalks with smooth bark are preferred for this method. The head of the stalk is left on until spring, and cut back by degrees.

Although the olive is so hardy and thrives on so many varieties of soil, yet no tree responds more quickly to intelligent culture and fertilizing. Trees need manuring and pruning, and when the annual rainfall is insufficient, even requires irrigation. The surface must be stirred by the plow, weeds must be destroyed, and manure dug into the soil. Vegetable manures are recommended. The olive grows slowly, and the space between the trees is used for other crops while the trees are small. Corn and beans will do on some soils. The peach and other short-lived fruit trees are useful for this purpose planted with the olive, in alternate rows, and cut down when the latter requires the whole space. But the best combination is the olive and the grape. The soil that is best for one is also best for the other, and the grapes will soon more than pay the expenses of the plantation.

At Grasse, in the *Alpes Maritimes*, the part of France where the olive does best, and where also the orange, lemon, and perfume plants thrive, one hectare of bearing olives (2½ acres) is valued at $1,750. If the trees are thirty years old it is valued at $2,500. The owner of the land has two-thirds of the produce. A hectare on hills contains two hundred trees; in the valleys only one hundred and twenty-five. It is there thought that digging, pruning, manuring, and gathering the crop will involve a total cost per hectare of $68, or $27 20 per acre. The yearly returns may vary from $150 to nearly $300 per hectare. A tree of ten years of age ought to give a gallon of olives; at thirty years, eleven gallons; and go on increasing until it yields eighty-eight gallons, and, in rare cases, even twice this amount. Good olives ought to give an eighth of their volume in oil—that is, eight gallons of berries yield one gallon of oil. The yield varies, of course, with the variety; but this may be called a good average. A variety called the *Plants de Salon* is one of the richest in oil. *Mermillaou de Toulon* and *Saourine Grasse* come next.

These notes will serve to give our readers some idea of the way in which olives are grown in Europe, and the profits realized there. At some future date we may speak of the methods of making oil and pickles. But it is important for Californians to remember that the olive grows faster here than in Europe, and bears earlier. At Niles, Alameda county, a six-year-old tree bore fully a gallon of fruit last year. At eight years, good returns may be expected. The price obtained is also greater here than in Europe, and this should easily offset the greater cost of labor. Our methods of cultivating the soil are much better. Besides this the land used for olives in Europe is much of it exceeding rugged, and is like our steepest goat and sheep ranges. The foothills of our coast range and Sierra are in every respect more desirable, more easily worked, and will probably yield more per acre when the plantations have attained a sufficient age. It will thus be seen that we have every encouragement to plant this valuable tree.

Our Australian neighbors are taking hold of olive culture with characteristic energy, and Californian horticulturists must look to their laurels. The Melbourne *Leader*, the *Queenslander*, and other Australian journals give reports from which we learn that considerable has already been done. The olive crop ripens there in May and June. This year, at the Melbourne Gardens the following varieties ripened: *Picholine*, small, round fruited, early; *Blanquet*, oblong-berried, used for oil, late; *Verdale*, roundish, yielding fine table oil; *De Malta*, oval-fruited, heavy bearer; *Cornichon*, poor bearer, large fruit; *De Nyons*, elliptic fruit, as large as an Orleans plum, very prolific; *Beneray*, large fruit, shy bearer when young; *Boutignan*, small round berries, fine for pickles; *Caillon*, beautiful oval, free bearer; *De Crimée*, round fruit, as large as a damson plum. All these and many other varieties of olive are being tested at the Government expense and propagated for distribution in different provinces of Australia.—*S. F. Bulletin.*

HOW THE HOP CROP IS GATHERED AND MARKETED.

THE chief hop-growing district in the Eastern States is in the central counties of Otsego, Madison, Oneida, and Schoharie. The States of Michigan and Wisconsin also produce a large quantity, and hops are raised in abundance in California, Oregon, and Washington Territory. Those raised on the Pacific coast are generally of superior quality, as the strong, rich soil causes a luxuriant growth. The Western hops are also exceptionally clean. Indians and Chinamen are employed to pick them, and they not only do it more cheaply but better than the native American. In Central New-York the crop is picked mainly by women and children, who migrate from the large cities to the hop country for a few weeks to secure the crop for the farmers. Some are paid by the day, and others by the boxful, and they usually earn about a dollar per day. In this State, 500 pounds per acre are considered a fair yield, and 1,000 pounds very good. On the rich soil of the West, however, 2,000 pounds per acre are frequently grown. The field hops are trained on poles in the same way as in an ordinary yard. The cost of raising them, including harvesting and drying, is about 12 cents per pound. This is after the hop-yard is well established, and the kiln for drying constructed. The vines will ordinarily bear well for fifteen years after planting. The hops of the first year's crop, called "seedlings," mature the earliest.

After being dried the hops are packed by means of a patent press in bales, 4½ feet in length, 2½ feet in width, and 18 inches in thickness, and weighing about 200 pounds. Hops lose about one-third of their strength in one year, so that old hops sell much cheaper than new. This tempts unprincipled growers to mix the old with the new when they have any of the former left over. The experienced dealers, however, easily detect the fraud. Hops are seldom sold in the Produce Exchange, though malt is much dealt in there. In London there is a large Hop Exchange in a very fine building.

The yield of hops in the United States in 1878 was estimated at about 150,000 bales, and last season 100,000 to 115,000 bales. Most of the crop comes to the New York market, fully seven-eighths of that grown on the Pacific slope reaching New York. From present indications the yield this year seems likely to be about the same as last year in extent, but will not be of as good quality, and so cannot be so extensively exported.

It is estimated that not over 5,000 bales are used in this country annually to manufacture medicinal liquors, and only a small fraction of the crop for bread yeast. The rest is made into malt liquor, mainly lager beer. Ale is rapidly declining in favor in this country, and the ale breweries are being turned to the manufacture of lager. Last year about 12,000,000 barrels of lager beer were made in the United States, and the revenue stamps at $1 a barrel brought a good income to the Government. The beer makers make immense profits, though it takes about $100,000 to start an ordinary brewery, and one firm in New York has that amount invested in barrels alone. After all, it is the consumers that pay the tax to the Government when they pay 5 cents per glass for the beer. No matter how much hops may vary in price, or beer by the barrel, the price of lager per glass remains at 5 cents. In making lager, malt, hops, Irish moss (for clarifying), and some sweetening are used, with the requisite amount of water.—*N. Y. Tribune.*

ROSES IN ENGLAND—RECENT PERSONAL OBSERVATIONS.

THE principles of rose culture are the same the world over; hence it follows that the majority of roses which succeed best in England will also be the finest here; the exceptions to this rule are noted below. The varieties which one sees in the greatest abundance at the English exhibitions are Marie Baumann, Alfred Colomb, La France, Baroness Rothschild, and Charles Lefevre. These five sorts would also be found in most of the successful stands here, but there are certain types which succeed better in one country than in the other, owing to the differences of temperature and climate. In this country we can grow the very full sorts better than in England. Varieties like General Washington, Countess of Serenye, Madame Boll, etc., are seen to the best advantage here. There is one exception to this, viz., Madame Lacharme. One would suppose that this sort would succeed best here, but the reverse is the case; while not reliable in England, I have there seen much better blooms of Madame Lacharme than ever flowered here. Roses with thin petals and medium substance, like Dr. Audry, Duke of Edinburgh, etc., suit the English climate much better than ours; so also do the very dark sorts, like Prince Camille, Jean Liabaud, Baron de Bonstetten, and those beautiful ones of Mr. Paul's raising—Sultan of Zanzibar, Duke of Connaught, and S. Reynolds' Hole. All these dark crimson roses burn very fast in our hot suns, and are only good at the first bloom for three or four days in the spring. Prince Camille sometimes gives a few passable blooms in the autumn, but the others furnish none at all; they are June roses only. In England roses start earlier than they do in Rochester, but their growth is very slow, and when the blooms come they last much longer than do ours. While our roses start later, when once they do commence to grow, they advance with great rapidity, and push forth an immense quantity of flowers, which bloom almost at the same time. Thus it is that in England one can see individual flowers in somewhat greater perfection than here, while we can display a greater mass of bloom. The slow growth of the English roses enables one in England to gather flowers late in the season from varieties which are mere summer sorts in America, like the dark varieties named above. In the suburbs of London, during the middle of August, I have seen plants of Cheshunt Hybrid covered with flowers; the same variety in Rochester, at the same time of year, would not bear the trace of a bloom.

The great rose exhibition of the National Rose Society was held at the Crystal Palace, July 3, but the season being a little late, Messrs. Cranston & Co. were the only ones of the large growers who exhibited in full force. Nevertheless, the show was a very interesting one. We had tickets which admitted us to the show half an hour before the public opening, but the half hour expired before we had half examined the collection; and so soon as the public gained admittance there was an end of making notes and of critical examination. Such a crowd as there was here struggling for admission scarce allowed an approach to the tables. Messrs. Cranston & Co carried off most of the prizes for nurserymen, as was to be expected. In the different classes they showed very fine blooms of Horace Vernet (one of the most distinct and beautiful dark roses), Baroness Rothschild, La France, Madame Lacharme, La Rosiere (or Prince Camille), Marquise de Castellane, Wilhelm Koelle (about the same as Alfred Colomb), Madame Charles Wood, Francois Michelon, Jean Liabaud, Sir Garnet Wolseley, A. K. Williams (a beautiful new sort), E. Y. Teas (a fine rose, but not distinct), General Jacqueminot, and Countess of Oxford. Among the new roses not in commerce previous to 1877, the following were the best: Charles Darwin, a grand crimson rose (we hope it will suit our climate better than the other crimsons of Mr. Paul's raising), Mrs. Laxton, Penelope Mayo, Cannes La Coquette, Glory of Cheshunt, R. N. G. Baker (Mr. G. Paul's novelty for the coming season), in the style of Marie Baumann, Duke of Teck, Madame Alexander Bernaix (a hybrid tea which seems to be a worthy companion for La France), Hon. George Bancroft and Duchess of Connaught (also hybrid teas), Madame Lombard (tea), Egina, and Paul Jamain. All these seem thoroughly good, and I should advise any one who has not got them to give each of these a careful trial.

The best roses in this exhibition were those in the collections of Messrs. J. Jewitt and R. N. G. Baker, two of the leading amateurs of England. The judges must have found it a very nice matter in determining upon the award between these two fine exhibits. These rose shows serve a very useful purpose in educating the minds of the public, encouraging a love for the beautiful, and by bringing together in comparatively small compass the cream of the roses. The first thing we look to in a rose is the beauty of the flower, and these exhibitions furnish the most convenient means of determining the superior sorts. When these are known, then it becomes necessary to see these sorts in growing condition, to ascertain the habit of the plant, whether of free-blooming properties, etc.

The National Rose Society has accomplished very great good, but we hope it will branch out into something wider, and use its influence to greatly shorten the immense list of varieties with which we are now encumbered—varieties which are called distinct, but which have no real difference. What does a grower care whether one variety has smoothed wood and another has thorns, if there be no essential difference in the blooms? If such a variety as Marguerite Brassac or Wilhelm Koelle do not show some marked improvement over their relatives, Charles Lefevre and Alfred Colomb, they should be stamped out as early as possible. A committee of such men as Messrs. Paul, Cranston, and Turner, who grow roses on an extensive scale, have excellent opportunity of determining the value of new sorts at an early date. Add to these such judges as the president and secretary of the society, and the dictum of such a committee, in relation to this and other subjects with which they are charged, would be of very great benefit.—*H. B. Ellwanger, in Country Gentleman.*

THE CUT TEA ROSE TRADE.

MR. W. E. MEEHAN, Philadelphia, writes in the *Gardener's Monthly* for September:

Of the roses that are forced for the cut flower market, teas, Safrano, Bon Silene, Isabella Sprunt, Cornelia Cook, Douglas, and Niphetos; noisette, Marechal Niel; hybrid perpetual, Jacqueminot; hybrid tea, Perle des Jardins, are the principal. Others, like Mad. Capricine, Malmaison, La France, and Paul Neron, either have not paid the grower for forcing, or for some other cause had, or will have, but a brief existence in the flower market. The others, it is safe to say, will always be forced, especially the first mentioned, viz., Safrano, Isabella Sprunt, and Bon Silene, the subjects of the present article. Safrano is a deep saffron color, Sprunt a pale sulphur yellow, and Bon Silene a deep pink.

These three have become a necessity to the florist, and cannot well be done without, Safrano and Sprunt being used for all and every kind of work—in funeral pieces, especially, Safrano being in demand, its rich saffron hue giving a clear relief to the otherwise dead white of the design. In Philadelphia not less than 15,000 of these three roses are used daily; in New York and Boston the amount consumed is probably nearly double that quantity, so that in the three cities there can hardly be less than 70,000 roses used daily. Indeed, it is more than probable that these figures, if an accurate count could be had, would be found to be far below the actual number consumed.

Except, perhaps, Jacqueminot, no rose is "bulled" and "beared" to such an extent as are these three. In New York, during the busy season, when the price is naturally high, the writer has known it to vary $2 and $3 a hundred inside of twenty-four hours. On one occasion, especially, when a great scarcity and demand was expected, the growers by storage bulled the roses to $15 a hundred, when, in consequence of an overload and an unexpected stand against the price, made by the retail men, the figure broke and the roses sold in the afternoon at all figures, varying from six to eight. This, of course, caused considerable loss and sickness among the growers, who could, before the break, readily have disposed of their stock at a slight advance on eight. Such a bulling transaction is not expected again soon. Only once since that did these roses reach fifteen, and that was by a natural rise in the market, the crop having for a long time been short and the demand heavy.

As the prices of these three teas vary so much, rarely being steady for more than two or three days, of course nothing more than a doubtful monthly average can be made. The following table will give it as nearly accurate as it is possible for the writer to make it:

November, first half, per 100	$1.50
do. second half, do.	2.50
December, first half, do.	5.00
do. second half, do.	$8.00 to 12.00
January	6.00
February	6.00
March*	3.00
April†	3.00
May	2.00
June	2.00
July, first half	1.50
do. second half	1.00
August	1.00
September	1.00
October	1.00

Contracts for the whole, or certain quantity of the stock, are made for the season, viz., From November to May, at $3 per 100.

The Boston growers have another system of contracts, which is about as follows: Nov. $2, Dec. $5, Jan. $5, Feb. $4, March $3, April $3. The grower, in three cases out of four, has the best end of the horn on either contract, and retail men are rapidly finding this out and less contracts are made. The best Safrano, Bon Silene, and Sprunt roses, taking the number of growers, are raised in Boston. The best individual grower in the country is among a community of florists on Union Hill, near Jersey City.

A HORSE-SHOER'S EXPERIENCE.

NINE persons out of ten will say that corns in horses' feet are caused by bad shoeing. My experience will justify me in saying that nine-tenths of the corns are caused by the owners of horses neglecting to get them shod as often as they ought. We are nearly all agreed that horses should be shod as often as once in every four to seven weeks, according to circumstances. Now, a great many horse owners, particularly farmers, will get a team shod, and, unless the horse becomes lame, will permit the shoes to remain on until they *grow off*.

If the horse has a round foot, and the shoe was fitted close all around, in four or five weeks the shoe will have been carried forward by the growth of hoof, so that one or both of the heels will be off the wall, and in a short time corns will be produced. Now, if the owner would take his horse to the shop on some fixed date every month, instead of leaving the shoes on from seven to twenty weeks, horses would have fewer corns. In shoeing I prefer a wide heel, and mule the heels of the forward shoes whether they have corns or not, on horses that have flat feet.

For interfering, level the foot and fit the shoe all around close. Then mule the inside heel slightly. In winter it is a good plan to turn the outside heel-calk, as it keeps the foot out of the trough of the road.

For over-reaching I have the best success shoeing with long shoes all around. Let the heels of the forward shoes stick out an inch, and the hind shoes three-quarters of an inch. As the forward foot raises the long shoe will raise enough so the hind foot will pass under, while with a short shoe the shoe will raise just enough for the hind shoe to hit the heels, causing a disagreeable clicking. I can do better and quicker work with knife and rasp than with buttress. If the foot is grown out very long I take the cutting pliers and nip the hoof off from quarters to toe. This insures the removal of the stubs of nails, and with a sharp knife and rasp, the foot is soon ready.

I practice cold-fitting, although I do not think a thick-shelled foot is injured by touching it with a red hot shoe that was previously fitted. A thin shelled foot I never press with a hot shoe. Was taught to weld toe-calks on shoes first and heel up afterward, but I practice heeling shoes first and put on the toe-calk when ready to use the shoe. If you toe last there will be heat enough in the shoe after welding the calk to fit the shoe. I let the heels which are nearly cold drop on the wall of the foot and hold the toe, which is red hot an inch away from foot while fitting. After the shoe is fitted and level, harden the toe, and nail on. I know a great many advocate heating a shoe red hot after the foot is prepared and the shoe fitted, and press the foot for an instant with the hot shoe. But all the advantage they claim is an equal bearing and that the shoe will be less liable to come off. Now I can with knife and rasp get as good a bearing, and with a good nail fasten the shoe so that it will stay longer than it ought.—*J. W. Nichols, in Blacksmith and Wheelwright.*

* If Easter, higher. † If Easter, higher.

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